# Some Actiniaria (Cnidaria: Anthozoa) from the west coast of India

J.C. den Hartog & J. Vennam

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Key words: Actiniaria; India; descriptions; cnidom; distribution; new species.

A small collection of five species of Actiniaria from the west coast of India, including three new species, is described and discussed. It concerns: *Anthopleura anjunae* spec. nov., *Bunodosoma goanensis* spec. nov., *Synantheopsis parulekari* spec. nov., *Paracondylactis* cf. *sinensis* Carlgren, 1934, and *Stichodactyla haddoni* (Saville-Kent, 1893). Details are given on the synonymy, cnidom and distribution of these species.

J.C. den Hartog, Nationaal Natuurhistorisch Museum (NNM), P.O. Box 9517, 2300 RA Leiden, The Netherlands.

J. Vennam, National Institute of Oceanography (NIO), Dona Paula, Goa-403 004, India.

## Contents



## Introduction

The present paper deals with some interesting samples of Actiniaria from the west coast of India collected between 1980 and 1990, which were donated to the Nationaal Natuurhistorisch Museum (NNM) [incorporating the former Rijksmuseum van Natuurlijke Historie (RMNH)], Leiden, by the junior author, when she spent there a period of one and a half year (November 1989 - June 1990) as a visiting scientist.

Considering that the present collection of only five species contains three species that are new to science, the conclusion seems justified that the actinian fauna of India is still poorly known, even if there is a fair number of publications on the subject. However, with few exceptions, these publications are little detailed, and added to this that collection and type depositories are often unknown or virtually inaccessible, the identity of many species described from the region cannot be verified, thus remaining doubtful or even enigmatic.

The most recent papers dealing entirely or in part with Actiniaria from the coast of India are a review by Parulekar (1990) and two papers by the late England (1987; 1990), the latter containing descriptions of two new species.

## Descriptions

Remark: The following codes are used in the nematocyst surveys of the species (tabs. 1-4, 6): +++ = very common, ++ = common, + = rather common, - = uncommon, - - = rare, - - - = sporadic; +/++ = rather common to common; -/+ = uncommon to rather common; etc.; ? = data insufficient to suggest numbers due to the condition of the tissue concerned; inc. = inconspicuous and easily overlooked (cf. den Hartog et al., 1993: 5)

### Family Actiniidae Goldfuss, 1820

### **Anthopleura** Duchassaing & Michelotti, 1860
### **Anthopleura anjunae** spec. nov.
(figs. 1-17)

*Anthopleura midori*; Parulekar, 1968: 142, pl.1 fig. 7; Parulekar, 1990: 225 [misidentification].
Not *Anthopleura midori* Uchida & Muramatsu, 1958 : 112-113, fig. 1

Material.— RMNH Coel. 18428 (holotype, Goa, Anjuna, rocky beach, intertidally in pools and wet crevices, iv-v.1989, leg. J. Vennam); RMNH Coel. 18429 (29 paratypes + some fragments, same data); RMNH Coel. 18430 (12 paratypes + some fragments, same data, iv-v.1990, leg. S.Y. Kamat).

Material examined for comparison.— BMNH reg. no. 1983.8.4.86 (India, Cochin, 1 specimen, coll. 1986 by Kurivilla Mathew; *Anthopleura nigrescens* (Verrill, 1928), det. K.W. England); BMNH reg. no. 1983.8.4. 107.108 (India, Mandapam Camp, on coarse sandstone rock, west end of Pamban, 1 fm, 1 specimen [of two], 19.ii.1963, coll. C.E. Cutress; *Anthopleura waridi* (Carlgren, 1900), det. K.W. England)

Morphology (figs. 1-12).— The specimens are firm, mostly semi- to fully contracted. Most specimens are damaged; in many of them the base is torn or even missing, revealing disorganized internal organs (filaments, retractors, parts of the stomodaeum).

Base more or less circular to elliptical in outline, ca. 7.5 × 7.5 to 27 × 20 mm, but up to 40 × 29 mm in one exceptionally large specimen.

Column entirely densely covered with conspicuous button- to cup-shaped verrucae, about 1-1.5 mm in cross-section, except near the margin where they are smaller. The verrucae are often distinctly stalked and strongly adherent to foreign particles such as fragments of shells, large sand grains, barnacles and calcareous worm tubes.

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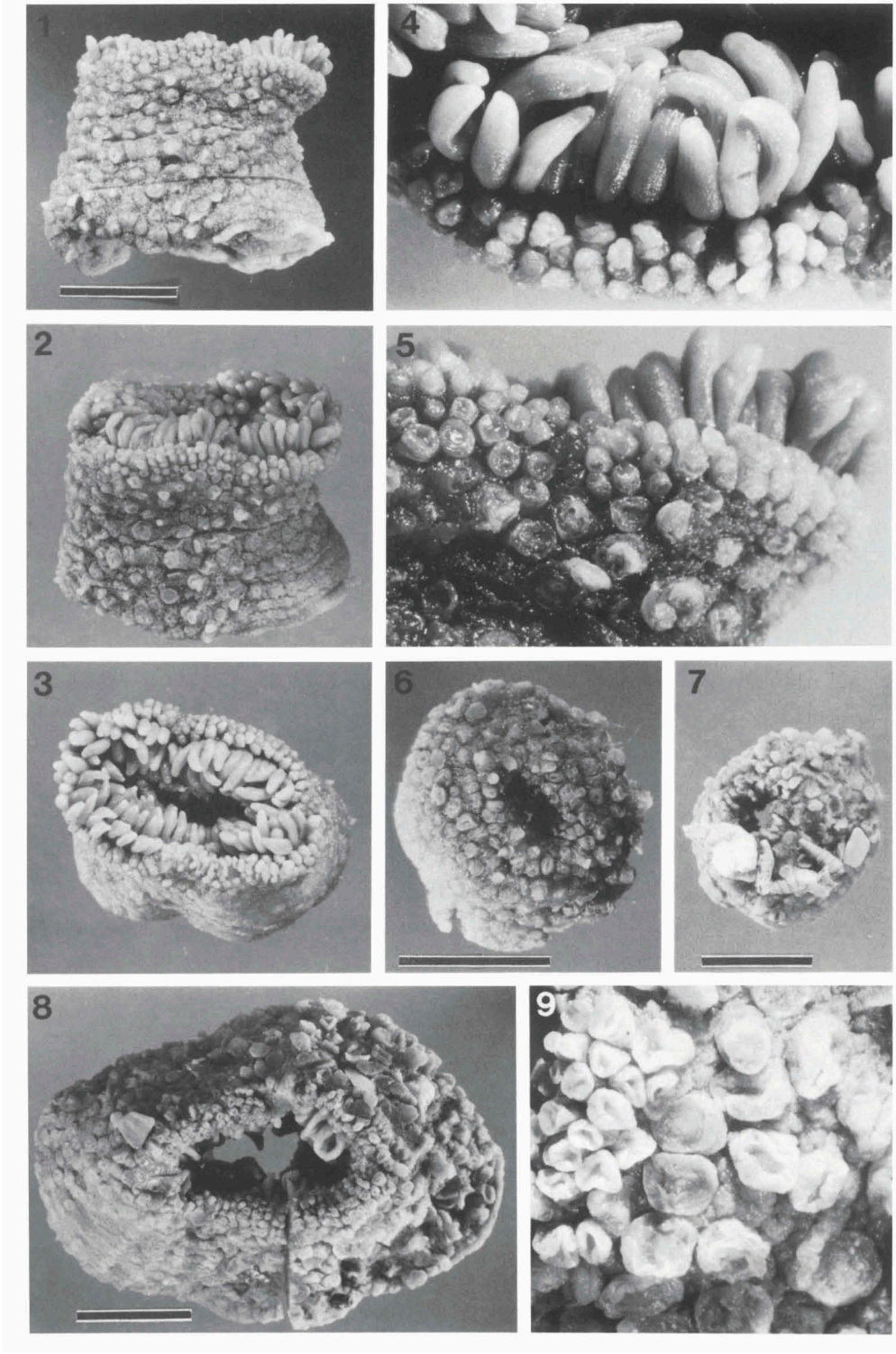
Figs. 1-9. *Anthopleura anjunae* spec. nov. External morphology. Figs. 1-5, different views of holotype (RMNH Coel. 18428) and enlarged details of marginal region showing verrucae and acrorhagi; fig. 6, paratype from sample RMNH Coel. 18429; fig. 7, paratype from sample RMNH Coel. 18430; figs. 8-9, largest specimen of type series (sample RMNH Coel. 18430) and enlarged detail of marginal region of its column. All scale bars 10 mm.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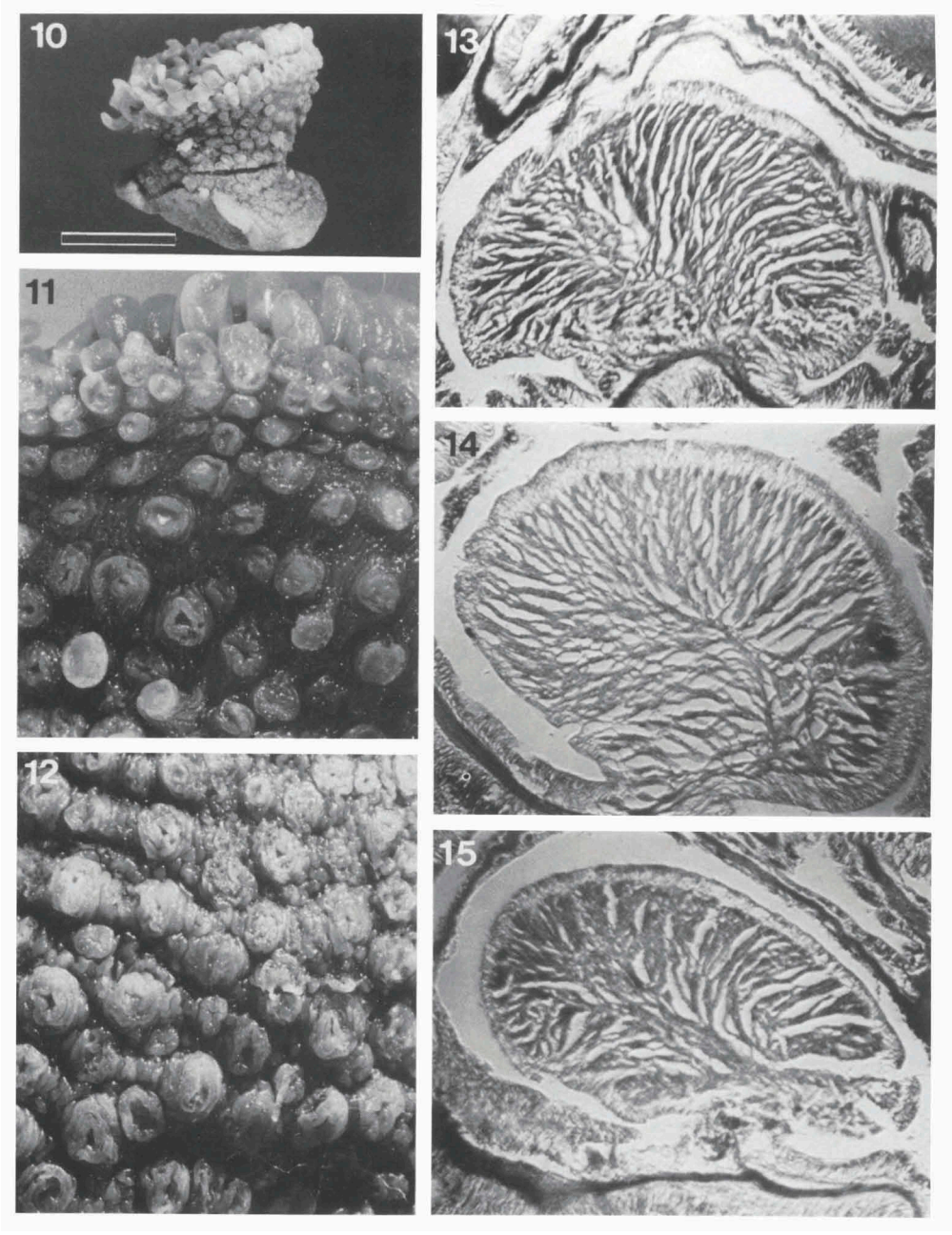



Figs. 10-15. *Anthopleura anjunae* spec. nov. External morphology and variation of marginal sphincter. Fig. 10, habitus of paratype from sample RMNH Coel. 18429; fig. 11, same specimen, enlarged detail of marginal region (note expanded and contracted verrucae); fig. 12, enlarged detail of column of another specimen showing dense arrangement of verrucae. Figs. 13-15, cross-sections of sphincters of three specimens of sample RMNH Coel. 18429. Scale bars: fig. 10 = 10 mm; figs. 13-15 = 0.25 mm.

In most specimens their arrangement is obscured due to the state of contraction, but even in more or less expanded specimens there are no distinct longitudinal rows, except distally, where short series of 3-6 smaller verrucae end marginally in a short more or less distinct marginal lobe, mostly with a distinct subglobular acrorhagus on its inner aspect (fig. 4). These lobes alternate with even shorter rows ending blindly at the margin or in a very indistinct lobe.

Details of oral disc and tentacular arrangement rather obscured; tentacles rather short, their number up to about 160 (128 in the largest specimen).

Colour (based on colour slides and notes of the junior author).— Column of live individuals dark greenish brown with distinct, pale to whitish verrucae with a reddish central area. Acrorhagi creamy to reddish. Base pale. Pattern of oral disc and tentacles variable. Tentacles semi-translucent, creamy to greyish, above with opaque creamy spots and cross-bars. Oral disc with numerous creamy to yellow and some dark radii. Directive radii white to cream in four expanded specimens shown in the available colour slides, running from the corners of the mouth to the directive tentacles and standing out against the dark central area of the oral disc. In addition, all these four specimens show a conspicuous brightly yellow streak in each of the corners of the mouth. Preserved specimens (in formalin-sea water) are dirty greyish to purplish brown with greyish tentacles and a pale base.

Anatomy (figs. 13-15).— Mesenteries as a rule more or less hexamerously arranged in four regular to slightly irregular cycles and part of a fifth cycle, their number proximally and distally equal or practically so. Mesentery cycles I-III perfect, inserting at different levels of the stomodaeum; cycle IV as a rule just reaching the oral edge of the stomodaeum. In none out of ten specimens examined cycle V was complete; therefore the number of mesentery pairs is probably always, or nearly always, less than 96. In seven full-grown, fertile, more or less undamaged specimens the number of mesenteries varied between 78 and 89. A small specimen of ca. 12 mm across had only three complete mesentery cycles and part of a fourth cycle, altogether 39 pairs. Due to the common occurrence of slight deviations from the hexamerous arrangement it proved not always possible to distinguish between the mesenteries of cycles I and II, but their sum varies between 10 and 14 pairs. Cycle III and IV usually complete, i.e. occupying all the secondary and tertiary exocoels and thus equalling the sum of the mesenteries of the previous cycles. Cycle V usually incomplete with pairs missing in the exocoels between cycles I and IV or cycles II and IV, never between cycles III and IV. Mesentery cycle I-IV fertile, the directives excluded. Cycle V poorly developed, imperfect, as a rule sterile, and only provided with trilobed filamental cord along its distalmost free edge; poorly developed gonads may be present in only some mesenteries of this cycle. In all except one out of 32 specimens examined there are two pairs of directives connected with distinct siphonoglyphs. In the only deviating specimen there is a double set of both directives and siphonoglyphs (RMNH Coel. 18429). Marginal stomata small but distinct, situated just below the sphincter; oral stomata larger. Sphincter rather strong, circumscript (figs. 13-15), ca. 0.5-1 mm in cross-section, located just below the fossa. Retractors of mesenteries well-developed, diffuse to restricted diffuse, outer face crenate in transverse section (undoubtedly correlated with the state of contraction). Parietobasilar muscles distinct, often with a small free flap. No zooxanthellae.

Cnidom.— A detailed survey of the cnidom of the species is presented in table 1 and fig. 16.

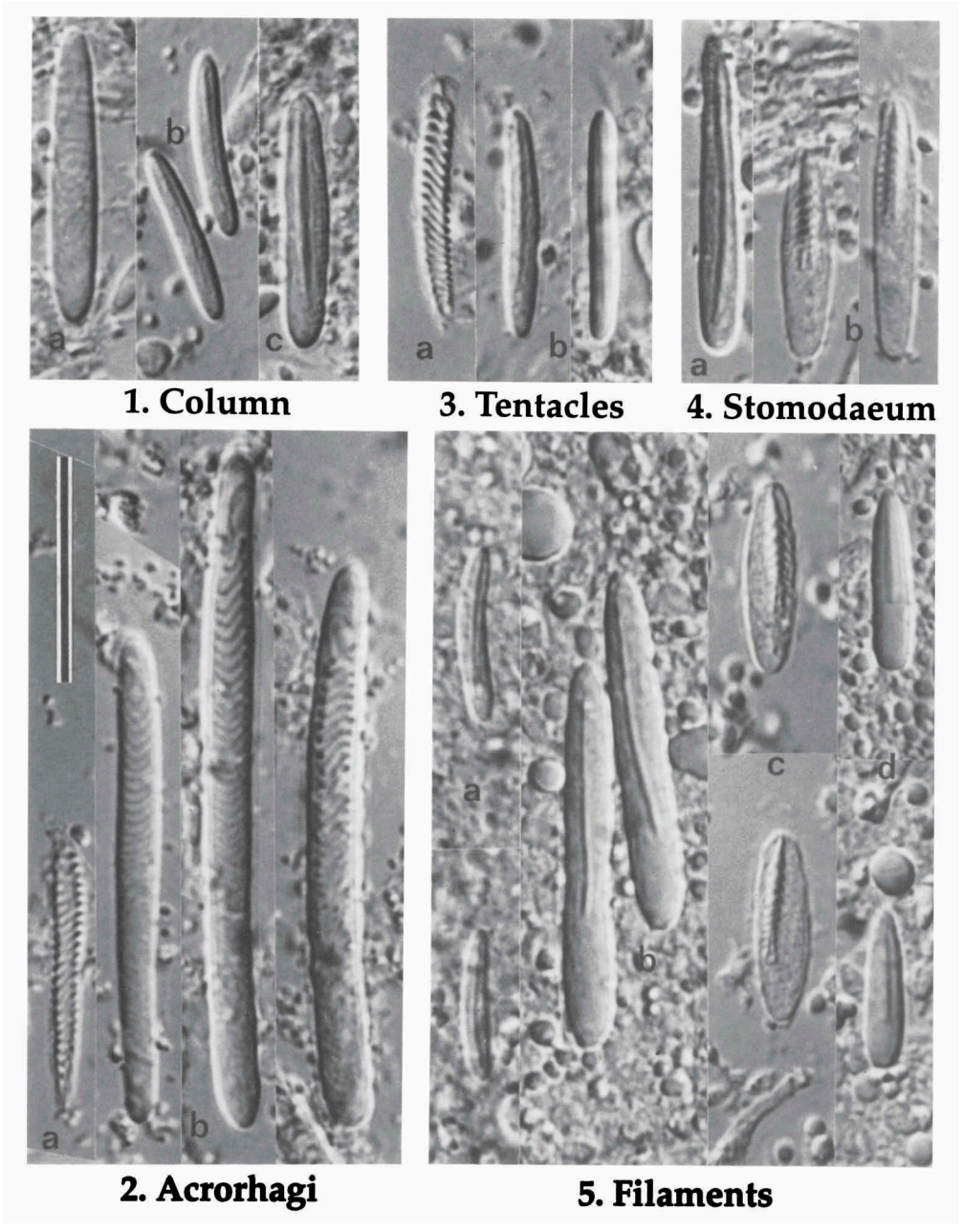



Fig. 16. *Anthopleura anjunae* spec. nov. Pictorial survey of the cnidom (based on RMNH Coel. 18429 and 18430). Figures and characters correspond with those in table 1. Scale bar 20 µm.
**1. Column**: a. Homotrich; b. Spirulae; c. Spirula. **2. Acrorhagi**: a. Spirocyst; b. Homotrichs. 3. **Tentacle tips**: a. Spirocyst; b. Spirulae. **4. Stomodaeum**: a. Spirula; b. Penicilli A. **5. Filaments**: a. Spirulae; b. Spirulae; c. Penicilli A; d. Penicilli $B_1$.

Table 1 (cf. fig. 16). *Anthopleura anjunae* spec. nov., survey of the cnidom of two paratypes (A = RMNH Coel. 18429; B = RMNH Coel. 18430; largest specimen). For the codes on frequency see "Remark" on p. 602.

| Organ | Nematocyst type | Specimen | Mean and range (in parentheses) of length and width of nematocyst capsules in µm | N | Frequency |
|---|---|---|---|---|---|
| 1. Column | a. Homotrichs | A | 23.0(19.8 - 26.1) × 3.3(2.7 - 3.6) | 20 | ++ |
| | | B | 24.1(19.6 - 29.4) × 3.1(2.9 - 3.6) | 20 | -- |
| | b. Spirulae | A | 13.5(11.7 - 16.2) × 2.0(1.8 - 2.3) | 25 | ++ |
| | | B | 13.7(12.0 - 16.7) × 2.1(1.8 - 2.4) | 40 | +++ |
| | c. Spirulae | A | 21.3(16.2 - 23.4) × 3.1(2.7 - 3.4) | 25 | ++ |
| | | B | 19.9(16.9 - 21.4) × 3.2(2.9 - 3.6) | 40 | + |
| 2. Acrorhagi | a. Spirocysts | A | ca. 20.0 - 27.0 × 2.7 - 3.2 | — | + |
| | | B | ca. 22.3 - 28.5 × 2.7 - 3.3 | — | + |
| | b. Homotrichs | A | 48.8(35.1 - 55.8) × 3.6(2.9 - 4.5) | 25 | +++ |
| | | B | 49.0(38.3 - 55.2) × 3.8(3.1 - 4.5) | 25 | +++ |
| | c. Spirulae | A | ca. 12.5 - 16.0 × 2.3 | — | --- |
| | | B | 13.5(12.5 - 15.1) × 2.1(1.8 - 2.3) | 10 | --- |
| 3. Tentacle tips | a. Spirocysts | A | ca. 12.5 - 25.0 × 2.0 - 3.2 | 20 | +++ |
| | | B | ca. 13.4 - 25.0 × 2.0 - 3.1 | — | +++ |
| | b. Spirulae | A | 18.5(16.2 - 20.7) × 2.3(2.0 - 2.5) | 30 | +++ |
| | | B | 19.8(17.8 - 22.3) × 2.5(2.2 - 2.9) | 20 | +++ |
| 4. Stomodaeum | a. Spirulae | A | 24.0(17.1 - 27.5) × 2.7(2.5 - 2.9) | 30 | ++ |
| | | B | 23.4(19.6 - 26.7) × 2.8(2.7 - 3.1) | 30 | ++ |
| | b. Penicilli A | A | 18.6(17.1 - 20.7) × 3.5(3.2 - 3.8) | 20 | + |
| | | B | 19.0(16.9 - 20.5) × 3.9(3.3 - 4.5) | 20 | - |
| 5. Filaments | a. Spirulae | A | 14.0(12.6 - 15.3) × 2.1(2.0 - 2.3) | 25 | + |
| | | B | 13.8(12.5 - 16.0) × 2.2(2.0 - 2.2) | 25 | ++ |
| | b. Spirulae | A | 29.6(26.1 - 31.5) × 4.2(3.6 - 4.5) | 25 | + |
| | | B | 32.1(28.0 - 36.5) × 4.3(3.6 - 4.7) | 25 | + |
| | c. Penicilli A | A | 17.0(15.3 - 18.9) × 3.6(3.2 - 3.8) | 25 | + |
| | | B | 17.4(15.1 - 19.6) × 3.5(3.1 - 4.0) | 25 | + |
| | d. Penicilli $B_1$ | A | 14.2(12.6 - 15.8) × 2.8(2.7 - 2.9) | 20 | -- |
| | | B | 14.1(12.5 - 15.1) × 3.0(2.7 - 3.1) | 20 | -- |

The presence of small columnar homotrichs (1a) is a common feature in many species of *Anthopleura* (cf. e.g. England, 1987: 239; as heterotrichs). Their distribution in the column was checked in 12 specimens, which revealed that these nematocysts occur especially or almost exclusively in a narrow basal region around the limbus. Their numbers, however, vary considerably, from very common to rare, which may be correlated with the degree of spacing of anemones at the collecting site. It is interesting to note that the large size-class of columnar spirulae (1c) also tends to be strikingly more common near the base than elsewhere.

In addition to the nematocyst types listed in the table for the column, squash preparations of columnar ectoderm contained sporadic spirocysts (some 20-25 × 2.2-3.0 µm), fibre-like spirulae (ca. 28-33 × 1.3 µm) (cf. den Hartog, 1987: 545, fig. 10), penicilli A (ca. 16-18 × 3.6-4.5 µm), and larger homotrichs of the acrorhagial type. It is possible that the odd presence of these nematocyst types is due to contamination. This may hold in particular for the large homotrichs and the spirocysts, and possibly

even for the penicilli A (found in two specimens), but definitely not for the inconspicuous fibre-like spirulae found in some specimens. It should further be borne in mind that the presence of spirocysts and penicilli A in the column is a constant feature in a variety of other species of Actiniaria. The sporadic presence of such atypical nematocysts in a given organ of certain individuals of certain species may therefore represent an atavism (an almost disappeared plesiomorphy).

Discussion.— The species shows some resemblance in external morphology and colour with the Hawaiian *Anthopleura nigrescens* (Verrill, 1928) (see Dunn, 1974), a species reported also from the southwest coast of India (Cochin, Kerala State) by Mathew (1979: 77 fig.1, 78) and England (1987: 249), though unconvincingly so. *A. nigrescens* differs anatomically by the variable number of siphonoglyphs and the absence of directive mesenteries. Mathew, though mentioning a variable number of siphonoglyphs, did not explicitly remark on the presence or absence of directives, but her fig. 1 represents a siphonoglyph supported by a pair of directives with well-developed retractor muscles. Therefore it is safe to conclude that the specimens studied by Mathew either belonged to a different species, or at most represented a mixture of two or more species (possibly including *A. nigrescens* and *A. anjunae* spec. nov.). England's record is based on a single specimen (BMNH 1983.8.4.86) coincidentally(?) also collected by Mathew, again from Cochin (in 1968), and thus, taking into account what is said above, providing some reason for suspicion about its identity. A re-examination of this specimen revealed the presence of three siphonoglyphs without directives, definite proof that it is not *A. anjunae* spec. nov., and supporting England's identification as *A. nigrescens*. However, the specimen concerned is rather small (less than 1 cm long and across) and its condition far from optimal. Therefore, although England's identification is possibly quite correct, some reserve concerning the occurrence of *A. nigrescens* in India seems justified pending confirmation by new, sound records.

In addition to these unconvincing records of *A. nigrescens*, there are records of five other species of *Anthopleura* from the west coast of India, viz.: *A. pacifica* Uchida, 1938, *A. asiatica* Uchida & Muramatsu, 1958, *A. midori* Uchida & Muramatsu, 1958 (cf. Parulekar, 1968; 1990), *A. panikkarii* Parulekar, 1969, and *A. waridi* (Carlgren, 1900) (cf. England, 1987: 250-254). Efforts to obtain voucher specimens from India of the first three species and type material of *A. panikkarii* failed, so that we had to base ourselves entirely on existing descriptions. The first two species (whether or not correctly identified with the Japanese forms; cf. Uchida, 1938: 305-309, figs. 22-23, pl. 11 fig. 2; Uchida & Muramatsu, 1958: 115-119, figs. 3-5) were described by Parulekar (1990: 225-226) as solitary forms with relatively inconspicuous verrucae; they cannot therefore be identical with the present species. The species identified as *A. midori* and *A. panikkarii* are, in accordance with the present material, distinctly verrucate gregarious forms. A *panikkarii*, unlike *A. anjunae* spec. nov., was described as having 48 pairs of mesenteries and 96 tentacles; its cnidom also seems to be significantly different (cf. Parulekar, 1969: 594-595; presence of penicilli A in the column and size of penicilli A in the mesenterial filaments). The Indian species misidentified by Parulekar as *A. midori* might be the species here under consideration, but the details given are insufficient to be certain about this. The species is definitely not identical with *A. midori* Uchida & Maramatsu from Japan, which was described as having, like *A. panikkarii*, 96 tentacles and 48 pairs of mesenteries (cf. Uchida, 1938: 294, 296, 297 fig. 15; as

Fig. 17. Anjuna beach, type locality of *Anthopleura anjunae* spec. nov. and *Bunodosoma goanensis* spec. nov.

*Anthopleura stella* (Verrill, 1864); Uchida & Muramatsu, 1958: 112).

*Anthopleura waridi* (Carlgren, 1900) sensu England (1987: 250-254) differs from *A. anjunae* in several characters, those to be verified most easily being the inconspicous verrucae (England's largest specimen from India re-examined), the variable number of directive mesentery pairs and supporting siphonoglyphs, and the presence in the column of only one size-class of spirulae (basitrichs) against two in *A. anjunae*. Apart from this, we consider England's identification of *A. waridi* doubtful and in need of confirmation. Carlgren's original description of this species, due to complete desiccation of the single type specimen, was entirely based on a few notes and a coloured figure by the collector, Dr. H. Stuhlmann. Consequently, several details of the description are guesswork, such as the suggestion that the "very large papilla-shaped warts on the distal margin" (not shown in Stuhlmann's figure) represent pseudo-acrorhagi (with a query), which was Carlgren's reason to place the species in the genus *Bunodes* Gosse, 1855 [a name preoccupied by *Bunodes* Eichwald, 1854 (a genus of Xyphosura) (Neave, 1939: 501), and replaced by *Bunodactis* Verrill, 1899 (: 42)]. However, it is quite possible that these "warts" were true acrorhagi (a view we share with England) indicating a species of *Anthopleura*. As we don't know this for certain, the only holdfast for the identity of *A. waridi* remains the coloured figure by Stuhlmann and an indication of the size of the holotype (diameter of base 3 cm, height 2.5 cm). This provides a very weak basis for identification, even if England emphasized that the colour of the species is distinctive and diagnostic. We further

observe that England's largest specimen only measured 10 × 13 mm (England, 1987: 252). In conclusion, pending a redescription of *A. waridi*, preferably based on material from the type locality (Bawi Island, Zanzibar; cf. Carlgren, 1900: 133-134) fitting Stuhlmann's coloured figure (cf. Carlgren, 1900: pl. 1 fig. 17), we consider it a dubious species.

Reproduction.— The rather regular anatomy of *Anthopleura anjunae* spec. nov. and the absence of fission scars suggest that the species does not reproduce asexually.

Habitat.— The material of the present study came exclusively from the type locality, where the species is common in the intertidal zone among scattered exposed rock formations (fig. 17), in moist crevices and in shallow tidal pools together with *Bunodosoma goanensis* spec. nov.

Etymology.— The specific epithet *anjunae* (= from Anjuna) refers to the type locality, Anjuna beach, Goa.

Distribution.— So far exclusively reported from the type locality.

## **Bunodosoma** Verrill, 1899
## **Bunodosoma goanensis** spec. nov.
(figs. 17-29)

Material.— RMNH Coel. 18434 (holotype; India, Goa, Anjuna, on smooth rocks in rather exposed rocky intertidal area with thick growth of the green alga "*Ulva fasciata*" and red algae, leg. J. Vennam, iv-v.1989; dissected); RMNH Coel. 18435 (same data, ca. 50 specimens, partly dissected); RMNH Coel. 18436 (same data, iv-v.1990, 16 specimens); RMNH Coel. 18437 (India, Maharashtra, Ratnigiri, Malvan, without date, 1 specimen); RMNH Coel. 18438 (India, W Coast, Kanya Kumari, rocky intertidal region, 1987, 2 specimens); RMNH Coel. 18450 (India, Gujarat, Okha, reef region, intertidal, 1987, leg. S.Y. Kamat, 2 specimens).

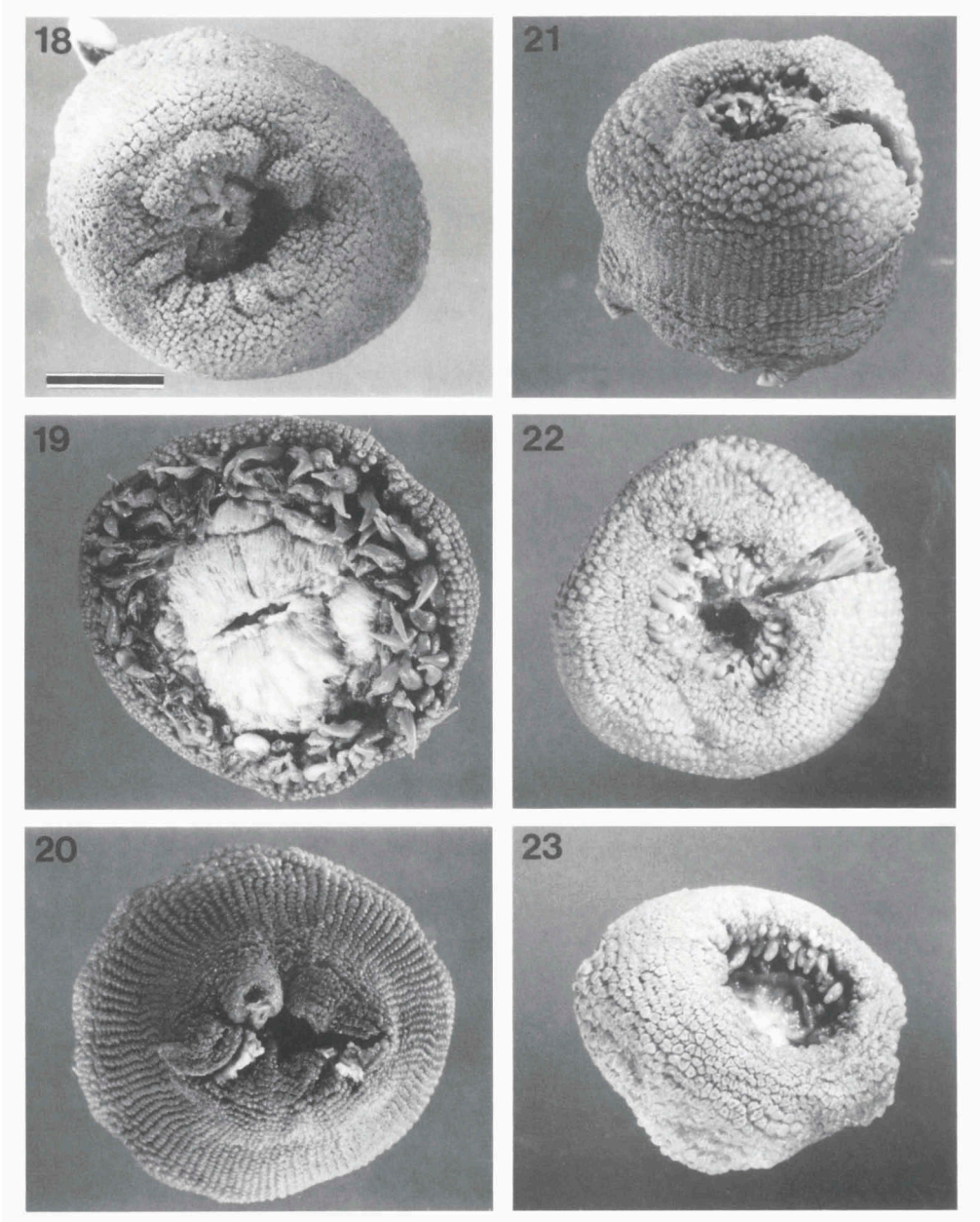
Material examined for comparison.— **Brazil**: RMNH Coel. 18715 (*Bunodosoma caissarum* Corrêa, 1964; Rio de Janeiro, Guanabara Bay, Governador Island, Pitangueiras beach, 6.xi.1991, 6 specimens; leg. S.M. Pinto).

Morphology (figs. 18-23).— Most specimens are contracted or semicontracted, the diameter of the base exceeding the height of the contracted column, and not very well preserved.

Base adherent, circular to semi-circular, up to ca. 3.5 × 3 cm across. Column densely covered with non-adhesive vesicular verrucae (cf. den Hartog, 1987: 552-555), mostly with no clear arrangement due to the state of contraction of the specimens, but in some less contracted specimens a clear arrangement can be observed in 96 endocoelic longitudinal rows; verrucae in middle and lower part of the column simple, tending to become compound distally; this is especially clear in the samples from Kanya Kumari (RMNH Coel. 18438) and Okha (RMNH Coel. 18450). Each row ends distally in a short marginal lobe, on its inner aspect provided with a distinct acrorhagus; lobes more or less arranged in two alternate crowns of slightly different size, with smallish and larger acrorhagi, respectively. In some specimens there are also small acrorhagi in connection with the exocoels. Marginal region in several specimens, both semi-expanded and contracted, more or less crenate or undulating (fig. 18).

Oral disc without special characters; contracted tentacles short and acute, their number exactly 192 in full-grown, regular specimens.

Colour (based on field notes and colour slides by the junior author).— The col-




Figs. 18-23. *Bunodosoma goanensis* spec. nov. External morphology. Fig. 18, paratype from sample RMNH Coel. 18436, note crenate margin; figs. 19-20, paratype from sample RMNH Coel. 18435, oral and basal view (base contracted); figs. 21-22, holotype (RMNH Coel. 18434), different views; fig. 23, specimen from sample RMNH Coel. 18435. Scale bar 10 mm

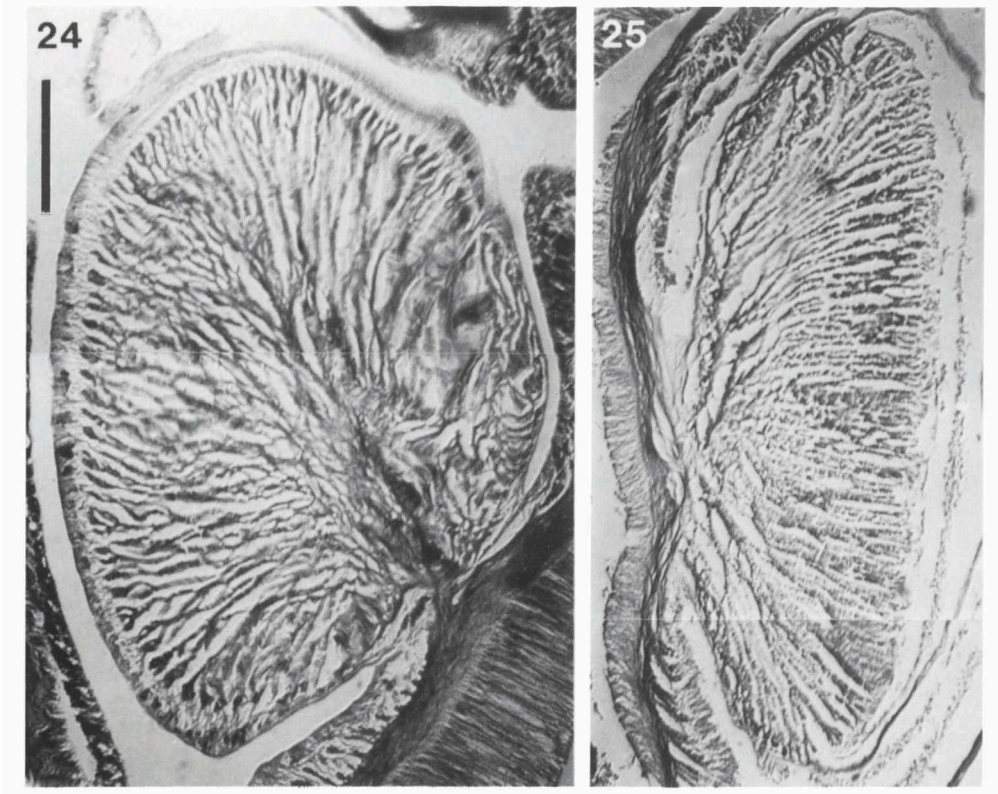


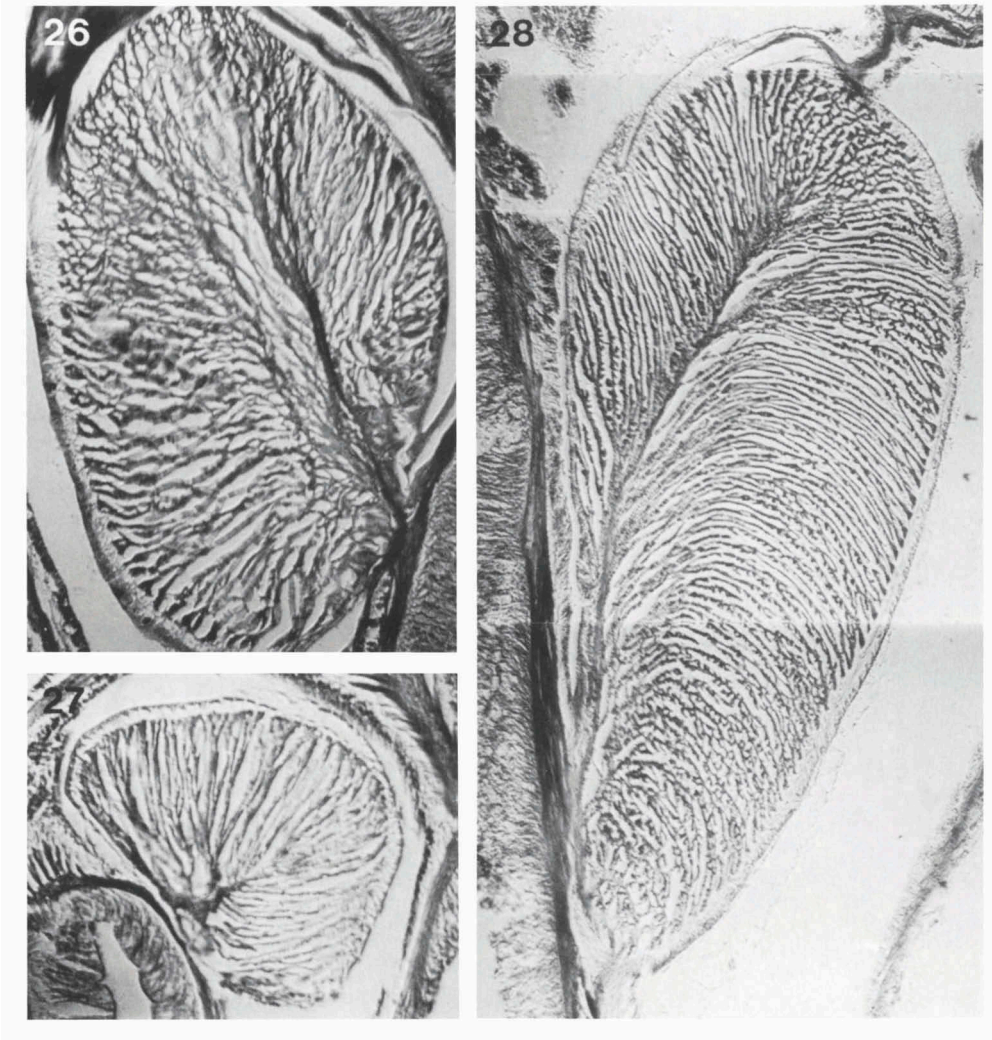

Fig. 24-28. *Bunodosoma goanensis* spec. nov. Variation of marginal sphincter in specimens from samples RMNH Coel. 18435 (figs. 27, 28), RMNH Coel. 18437 (figs. 24, 26; the same specimen; strongly reminescent of sphincter of holotype), and RMNH Coel. 18450 (fig. 25). Scale bar to all figs. 0.25 mm.

umn, tentacles and oral disc of live specimens are entirely brownish crimson to brick red in colour. Colour of acrorhagi not visible in the slides available.

Anatomy (figs. 24-28).— Mesenterial arrangement basically hexamerous in five cycles, according to the scheme: 6 + 6 + 12 + 24 + 48 = 96, but slight deviations are not uncommon, the number of mesentery pairs in several specimens examined varying between 94 and 100. Two pairs of directives connected with distinct siphonoglyphs. In some of the well-developed specimens that were dissected all mesenteries were perfect and fertile, the directives excluded. Oldest mesentery cycles united with stomodaeum over its entire length, the youngest cycle just reaching the oralmost part. Oral and marginal stomata distinct. Sphincter circumscript, distinctly pinnate (figs. 24, 26, 28) to palmate (figs. 25, 27), more or less orbicular to somewhat elongate in cross-section, moderately strong to strong with diameter varying between ca. 0.75 × 0.5 to 2.0 × 1.5 mm. Retractors of the mesenteries moderately strong, diffuse. Parietobasilar muscles distinct. No zooxanthellae.

Cnidom.— A detailed survey of the cnidom of the species is presented in table 2 and fig. 29.

In addition to the dominating types and size-classes of cnidae in the various organs, there are several categories that are rare to sporadic and on that account of




negligible diagnostic significance. One of these categories represents the controversial, somewhat curved to vaguely S-shaped, fibre-like structures in the filaments (5d). The nematocyst nature of these may raise doubts when studying squash preparations of preserved tissue, but in some species, e.g. in *Bunodosoma biscayensis* (Fischer, 1874), they have been observed in discharged condition in preparations of fresh tissue, and were positively identified as spirulae (cf. den Hartog, 1987: 543). The homotrichs in the column are most abundant near the limbus (as in most other species of *Bunodosoma* and *Anthopleura*; cf. the former species, *Anthopleura anjunae*). The common presence of penicilli $B_1$ in the filaments (5f) is noticeable; in addition to the usual size range of these cnidae, the odd presence of examples of larger size (5g) was established.

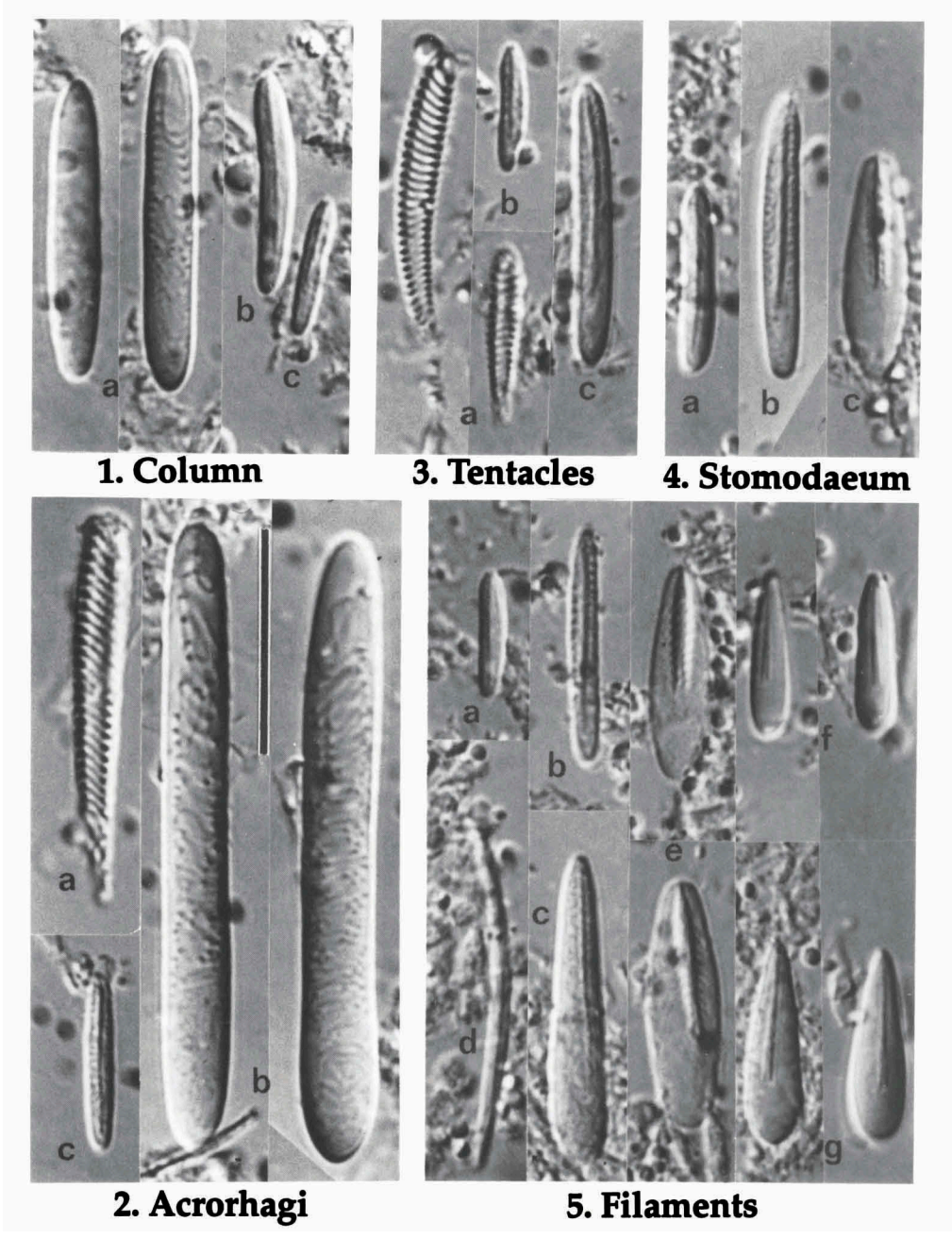



Fig. 29. *Bunodosoma goanensis* spec. nov. Pictorial survey of the cnidom (based on RMNH Coel. 18435 and 18436). Figures and characters correspond to those in table 2. Scale bar 20 µm.
**1. Column**: a. Homotrichs; b. Spirula; c. Spirula. **2. Acrorhagi**: a. Spirocyst; b. Homotrichs; c. Spirula. **3. Tentacle tips**: a. Spirocysts; b. Spirula; c. Spirula. **4. Stomodaeum**: a. Spirula; b. Spirula; c. Penicillus A. **5. Filaments**: a. Spirula; b. Spirula; c. Spirula; d. Spirula; e. Penicilli A; f. Penicilli $B_1$; g. Penicilli $B_1$.

Table 2 (cf. fig. 29). *Bunodosoma goanensis* spec. nov., survey of the cnidom of three paratype samples from India (A = RMNH Coel. 18435; B = RMNH Coel. 18436; C = RMNH Coel. 18437). For the codes on frequency see "Remark" on p. 602.

| Organ | Nematocyst type | Specimen | Mean and range (in parentheses) of length and width of nematocyst capsules in µm | N | Frequency |
|---|---|---|---|---|---|
| 1. Column | a. Homotrichs | A | 27.2(24.3 - 30.6) × 4.2(3.6 - 4.5) | 20 | + |
| | | B | 25.5(22.5 - 27.5) × 3.7(3.4 - 4.1) | 20 | + |
| | | C | 26.2(22.3 - 32.4) × 3.9(2.9 - 4.5) | 40 | -/+ |
| | b. Spirulae | A | 10.8(9.9 - 11.3) × 1.8 | 10 | - - |
| | | B | 11.1(9.8 - 12.5) × 1.8 | 5 | - - |
| | | C | 11.4(11.1 - 11.6) × 1.8 | 3 | - - - |
| | c. Spirulae | A | 18.9(12.6 - 23.4) × 2.6(2.3 -3.2) | 45 | ++ |
| | | B | 18.3(14.9 - 23.4) × 2.4(2.0 - 2.7) | 50 | ++ |
| | | C | 17.4(13.5 - 22.5) × 2.4(1.8 -2.7) | 60 | ++ |
| 2. Acrorhagi | a. Spirocysts | A | 35.5(31.5 - 38.7) × 3.9(3.4 - 4.1) | 20 | + |
| | | B | 34.5(26.7 - 39.2) × 3.6(3.1 - 4.0) | 20 | + |
| | | C | ca. 30.0 - 36.5 × 3.0 - 4.0 | — | + |
| | b. Homotrichs | A | 51.3(43.2 - 60.3) × 5.3(4.5 - 5.9) | 20 | +++ |
| | | B | 50.3(43.2 - 56.1) × 4.8(3.8 - 5.3) | 30 | +++ |
| | | C | 52.2(42.7 - 60.5) × 5.0(3.8 - 5.6) | 30 | +++ |
| | c. Spirulae | A | 17.3(15.3 - 18.9) × 2.3(2.3 - 2.5) | 20 | + |
| | | B | 17.6(16.0 - 18.7) × 2.3(2.2 - 2.4) | 4 | - - - |
| | | C | 17.0(15.1 - 18.7) × 2.2(2.0 - 2.5) | 10 | - - |
| 3. Tentacle tips | a. Spirocysts | A | ca. 15 - 27 × 2.5 - 3.6 | — | +++ |
| | | B | ca. 14.2 - 28.5 × 2.4 - 3.6 | — | +++ |
| | | C | ca. 13.5 - 27 × 2.4 - 3.6 | — | +++ |
| | b. Spirulae | A | 11.3(9.9 - 12.2) × 1.8(1.8 - 2.0) | 10 | - - |
| | | B | 11.0(9.8 - 12.0) × ca 1.8 | 8 | - - - |
| | | C | ca. 10 - 12 × 1.8 | 3 | - - - |
| | c. Spirulae | A | 22.3(19.8 - 25.2) × 2.6(2.3 - 2.9) | 60 | ++ |
| | | B | 21.1(20.3 - 22.5) × 2.3(2.3 - 2.5) | 20 | ++ |
| | | C | 20.4(18.7- 23.1) × 2.4(2.0 - 2.7) | 20 | ++ |
| 4. Stomodaeum | a. Spirulae | A | 15.9(14.4 - 17.1) × 2.3(2.3 - 2.5) | 10 | - |
| | | B | 15.3(13.5 - 18.0) × 2.0(1.8 - 2.3) | 20 | - |
| | | C | 14.4(13.8 - 15.1) × 2.1(2.0 - 2.3) | 4 | - - - |
| | b. Spirulae | A | 23.6(21.6 - 25.2) × 3.2(2.9 - 3.4) | 30 | + |
| | | B | 22.6(20.7 - 23.9) × 3.0(2.7 - 3.2) | 30 | + |
| | | C | 22.7(19.4 - 25.2) × 3.0(2.7 - 3.4) | 30 | ++ |
| | c. Penicilli A | A | 18.4(18.0 - 19.8) × 4.9(4.5 - 5.2) | 10 | - |
| | | B | 17.7(16.9 - 18.7) × 4.8(4.5 - 5.1) | 4 | - - - |
| | | C | 18.4(17.1 - 20.3) × 4.9(4.5 - 5.4) | 10 | - - |
| 5. Filaments | a. Spirulae | A | 12.4(10.4 - 13.5) × 1.8 | 10 | - [inc.] |
| | | B | 13.1(10.8 - 14.4) × 1.6(1.6 - 1.8) | 15 | - [inc.] |
| | | C | 12.3(11.3 - 14.0) × ca. 1.8 | 10 | - - [inc.?] |
| | b. Spirulae | A | 17.4(14.4 - 19.8) × 2.3 | 10 | - -? |
| | | B | 19.4(18.7 - 20.5) × 2.2(2.0 - 2.3) | 4 | - - - |
| | | C | 17.6(16.0 - 18.7) × 2.2(2.2 - 2.4) | 5 | - - - |
| | c. Spirulae | A | 23.8(19.8 - 33.3) × 4.4(3.6 - 5.9) | 40 | + |
| | | B | 29.3(24.3 - 36.0) × 4.4(3.8 - 5.4) | 20 | - |
| | | C | 29.6(23.4 - 36.0) × 4.4(3.6 - 5.0) | 20 | + |
| | d. Spirulae | A | 32.3(28.5 - 35.6) × 1.7(1.6 - 1.8) | 16 | - - - |

| | | | | |
|---|---|---|---|---|
| | B | 30.3(27.6 - 32.0) × ca. 1.6 - 1.8 | 4 | --- |
| | C | 33.2(31.2 - 36.0) × ca. 1.5 - 1.8 | 10 | --- |
| e. Penicilli A | A | 18.2(17.6 - 19.8) × 5.0(4.5 - 5.4) | 20 | + |
| | B | 19.8(18.9 - 21.6) × 4.7(4.5 - 5.0) | 20 | ++ |
| | C | 19.2(17.6 - 20.3) × 5.1(4.5 - 5.4) | 20 | + |
| f. Penicilli $B_1$ | A | 14.5(13.5 - 17.1) × 3.3(2.9 - 3.6) | 20 | ++ |
| | B | 16.2(14.9 - 17.1) × 2.9(2.7 - 3.2) | 20 | ++ |
| | C | 15.6(13.5 - 16.7) × 3.0(2.7 - 3.2) | 20 | + |
| g. Penicilli $B_1$ | A | 17.2(16.5 - 18.7) × 4.3(3.6 - 4.7) | 25 | --- |
| | B | 18.9(17.8 - 20.0) × 3.7(3.1 - 4.0) | 5 | --- |
| | C | 19.5(18.7 - 21.4) × 3.7(3.3 - 4.0) | 9 | --- |

Reproduction.— Sexes separate; no indications of asexual reproduction.

Etymology.— The specific name *goanensis* alludes to Goa, the type locality sensu lato.

Ecology and habitat (fig. 17).— Occurring intertidally attached to smooth rock surfaces, in moist crevices and in tidal pools in the exposed rocky area of Anjuna beach, Goa, marked by significant cover of green and red algae. Specimens were abundant in April 1989, but in July only a few very small individuals were encountered (observations J. Vennam). Prey in the form of some small unidentified intertidal gastropods was found in the coelenteron of a few of the specimens that were dissected.

Distribution.— So far exclusively known from the west coast of India (Gujarat, Maharashtra and Goa), but presumably more widely distributed.

Distinctive characters of the species.— A typical representative of the genus *Bunodosoma*. It strongly resembles the Brazilian *B. caissarum* Corrêa, 1964, in general morphology, anatomy, cnidom and colour. However, living, expanded individuals of *B. caissarum* are capable of considerable elongation, whereas *B. goanensis* seems to have a rather short column. A more concrete difference concerns the youngest mesentery cycle, which tends to be fertile in *B. goanensis*, sterile in *B. caissarum* (Belém, 1988: 372; den Hartog, unpublished). The cnidoms of the two species (and of several other species) are basically similar, even with respect to the common presence in the filaments of penicilli $B_1$ (5f, g) in two size-classes and the sporadic presence of the inconspicuous fibre-like spirulae (5d) which were overlooked by Corrêa (1964: 66) and Belém (1988: 371).

Discussion.— So far the tropical to warm-temperate genus *Bunodosoma* was exclusively known from both sides of the Atlantic and from the Pacific coast of America. In addition one species, *B. fallax* (Pax, 1922), was described from Amsterdam Island in the temperate southern Indian Ocean (37°55'S 77°40'E) (see also Pax, 1926: 79, and Carlgren, 1928: 249), but the generic identity of this species needs confirmation on the basis of freshly collected material. The type material (ZMB 7171; 4 fragments of 2 dissected specimens) does not allow recognition as a species of *Bunodosoma*; it could just as well belong in *Anthopleura* or another related genus. *Bunodosoma goanensis* spec. nov. is the first (non-suspect) species of *Bunodosoma* to be recorded from the Indo-West Pacific.

Parulekar (1968: 139, 142, pl. 11 fig. 6) and Hague (1977: 36, 39) reported on a species of *Bunodosoma* from Bombay and Bangladesh, respectively, which they misidentified as *Bunodosoma granuliferum* (Lesueur, 1817). The scanty descriptive notes provided by these authors and the figure given by Parulekar actually do nei-

ther allow recognition of the anemone concerned as a species of *Bunodosoma* nor contradict this. However, the colour notes alone are sufficient to distinguish it from *Bunodosoma granuliferum*, an otherwise exclusively Caribbean species, which has the column usually marked by alternating pale and dark grey longitudinal bands of (non-adhesive) verrucae. Even if the species mentioned by Parulekar turns out to be a species of *Bunodosoma*, it is unlikely to be identical with *B. goanensis* spec. nov.; the colour of the former is pink with the tentacles longitudinally striped red, that of the latter entirely brick red to maroon.

## **Synantheopsis** England, 1992

*Synantheopsis* England, 1992: 78 (diagnosis; type species *S. primus* England, 1992, by monotypy).

Diagnosis (adapted to include *S. parulekari* spec. nov.): Actiniidae with well-developed pedal disc. Column smooth with distinct, adhesive verrucae in marginal region only. Margin crenulate with papilla-like to club-shaped vesicular structures (pseudo-acrorhagi?). No acrorhagi. Up to 384 rather short and acute tentacles hexamerously arranged in 4-6 cycles; oldest cycle extending across the disc close to the mouth; no obvious difference in size between tentacles of older and younger cycles. Sphincter weak to very weak [England's statement that it is strong is an un-intentioned slip, as is clear from his description], restricted diffuse to circumscript. Number of mesentery cycles 4-5(6), the oldest 3-4 cycles perfect and fertile, the youngest cycle(s) sterile; retractors restricted diffuse, strong. Two pairs of directives, supported by well-developed siphonoglyphs ending in long aboral slips. Cnidom: spirocysts (characteristically many relatively large ones in lower part of stomodaeum), spirulae, penicilli A, penicilli $B_1$ (in filaments only). Zooxanthellae in endoderm of tentacles and oral disc.

## **Synantheopsis parulekari** spec. nov.
(figs. 30-39)

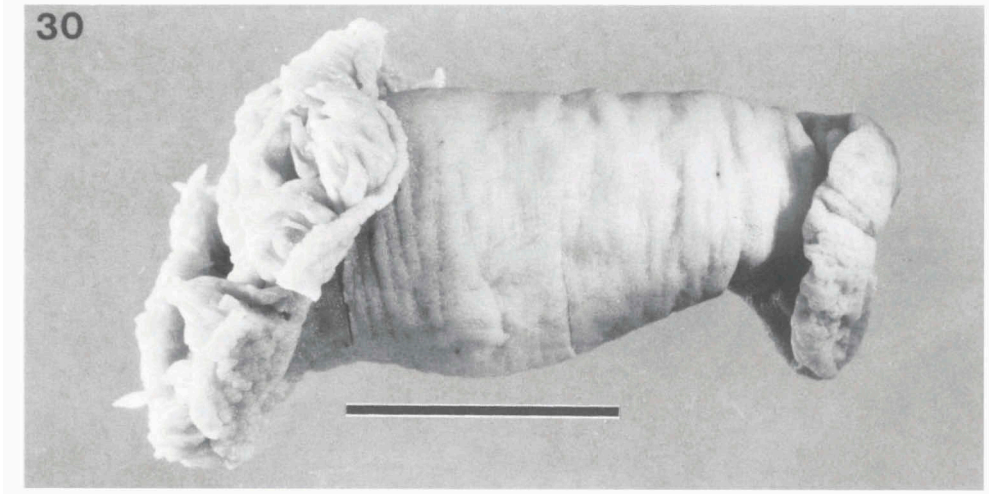
*Actinogeton sultana*; Parulekar, 1968: 140, 142 pl. 2 fig.11, 143 (Bombay) [misidentification]; 1990: 220, 223, 226 [misidentification].

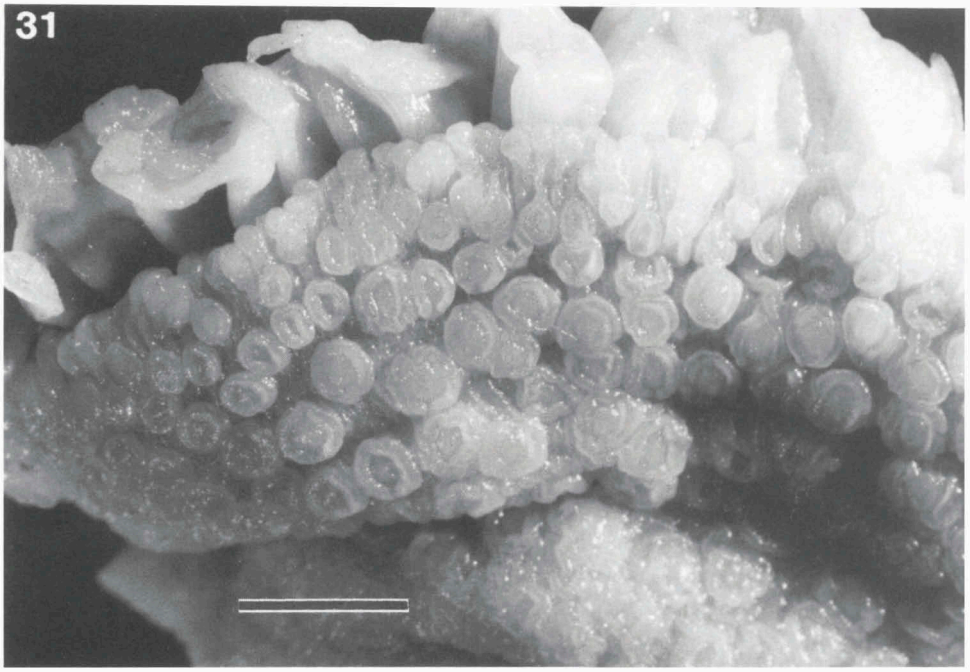
?*Synantheopsis primus* England, 1992: 80-82, figs. 14-15, tab. 9 [in the legend of fig. 15 the species is mistakenly referred to as *S. cheungae*; apparently a slip of the pen caused by the fact that the epitethet *cheungae* was proposed by England for another new species *Spheractis cheungae*, the description of which just preceeds that of *Synantheopsis primus*; cf. England, 1992: 75-79].

Material.— RMNH Coel. 18426 (Holotype; India, Gujarat coast, Okha, sandy tidal flat, burrowing in sand, leg. S.Y. Kamat et al., 1988); RMNH Coel. 18427 (paratype; same data); RMNH Coel. 18440, (Paratype; Thailand, Trang Province, Ko Libong, Ban Patn Puk, buried in sandy mud-flat, leg. C. Swennen, 30.x.1985).

Material studied for comparison.— BMNH reg. no. 1992.7.9.18 (holotype of *Synantheopsis primus* England, 1992; Hong Kong, New Territories, Hoi Ha village, by pier, iv.1989; coll. P.A. Hutchins).

Morphology (figs. 30-31).— Column of the specimens from India 7 to 8 cm long, distally expanding into a wide, somewhat flaring oral disc ca. 5.5 cm across, and



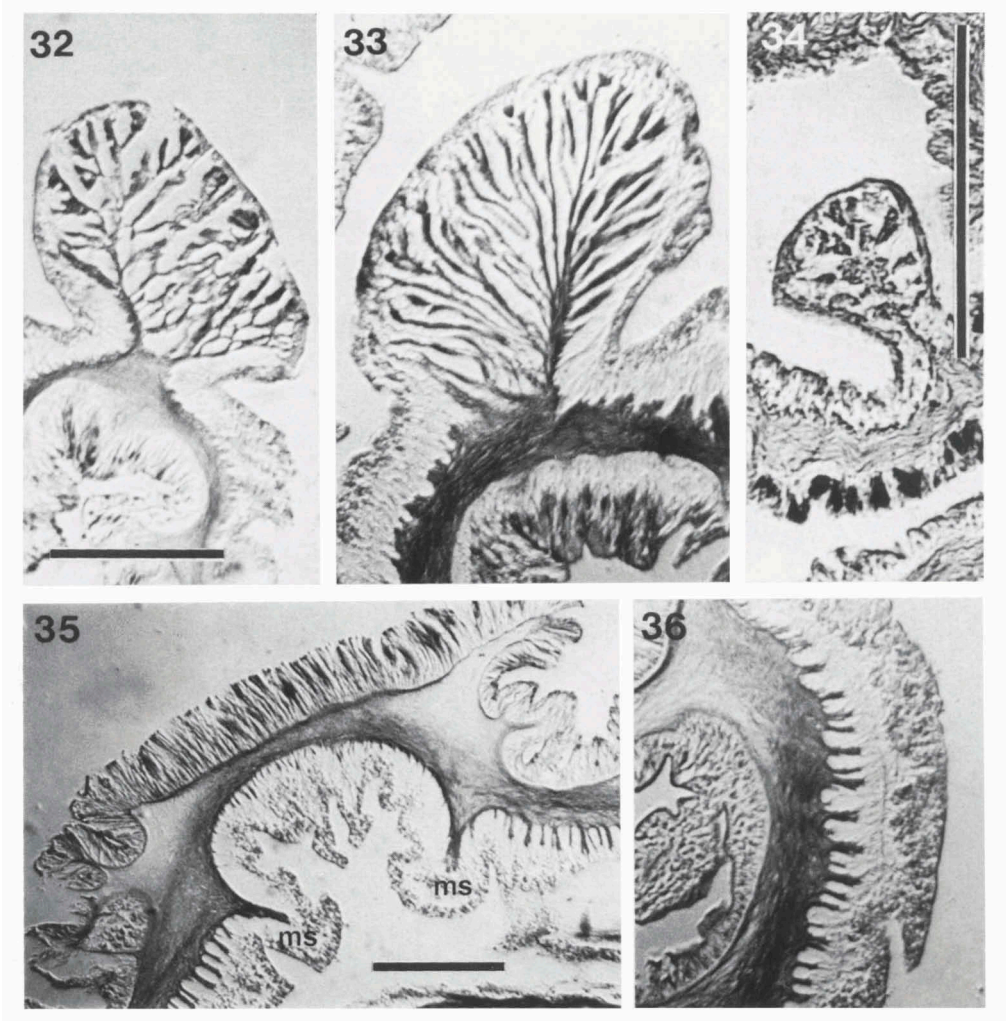

Figs. 30-31. *Synantheopsis parulekari* spec. nov. Habitus of paratype from Okha, India (RMNH Coel. 18427) and enlarged detail of its distalmost region showing prominent verrucae and marginal "pseudo-acrorhagi". Scale bars: fig. 30 = 30 mm; fig. 31 = 5 mm.

proximally ending into a distinct basal disc. Column narrowest just above the base. Upper, flaring part of the column, a zone of some 1.5 to 2 cm, densely set with large, prominent, button-shaped verrucae of ca. 1.5-2 mm in cross-section, except near the crenulate margin where they are much smaller. On the crenulate margin itself these verrucae take the shape of a dense crown of obtuse, somewhat papilla-like to vesicle-like outgrowths (which might be referred to as pseudo-acrorhagi) with a small

adherent area on the outer face. An arrangement of the columnar verrucae in longitudinal rows cannot clearly be distinguished, presumably due to the state of preservation. The rest of the column is smooth to slightly wrinkled. A slight constriction, separating the flaring, verrucate distalmost part of the column from the rest of it, does not coincide with the position of the sphincter.

Tentacles numerous, approximately 384 in hexamerous arrangement; they are simple, relatively short, and acute, ca. 8-10 mm long (in preserved condition).

Colour.— No data with the present material. According to Parulekar (1968: 143) the column is white to pale yellowish or pink, the base yellowish white.




Figs. 32-36. *Synantheopsis parulekari* spec. nov. Anatomical details. Figs. 32-34, variation of weak, slightly pinnate circumscript sphincter: fig. 32, RMNH Coel. 18427; fig. 33, RMNH Coel. 18426 (holotype); fig. 34, RMNH coel. 18440 (specimen from Thailand with small, degenerated sphincter). Fig. 35, cross-section of verruca (RMNH Coel. 18427; note endodermal circular muscle layer and mini-sphincter of verruca (ms)); fig. 36, detail of endodermal circular muscle layer. Scale bars 0.25 mm. Scale bar in fig. 32 applies also to figs. 33 and 36.

Anatomy (figs. 32-37).— Arrangement of mesenteries regularly hexamerous in five cycles according to the scheme 6 + 6 + 12 + 24 + 48 = 96 pairs, the number being proximally and distally equal. A complete sixth cycle of minute mesentery pairs without any trace of filaments or gonads is present in the distal region of the holotype; in the paratype from the type locality the sixth cycle is internally visible in the column-wall without actually emerging. This cycle might also be present in the distalmost part of the specimen from Thailand, but this could not be verified. Mesentery cycles I-IV, including the directives, are perfect and fertile, inserting at different levels of the stomodaeum wall; the mesenteries of cycle I are connected with the stomodaeum over its entire length, those of cycle IV only with the oralmost part. Cycle V is more or less microcnemic, sterile and devoid of simple filamental cord, but with trilobed filamental cord in its distalmost part. Whether this cycle just reaches the oralmost part of the stomodaeum could not be verified. Gonads and filaments of subsequent mesentery cycles extend over different stretches of the mesenterial edges, reaching distalmost and least proximally in the youngest cycle and most proximally and least distally in the oldest cycle. There are two pairs of directives connected with conspicuous, strongly developed siphonoglyphs with long aboral slips extending at least halfway down the column. Oral stomata distinct; marginal stomata minute. Marginal sphincter circumscript, somewhat elliptical, very weak in relation to body size, ca. 0.25-0.5 mm in diameter in mounted sections (figs. 32, 33). Endodermal circular muscle layer well-developed (figs. 35, 36) with distinct muscle processes which are better developed around the coelenteric apertures of the verrucae, so as to assume the character of mini-sphincters. Retractors of the (macro-) mesenteries well-developed, forming a broad diffuse band with slightly branched mesogloeal lamellae. Parietobasilar muscles rather short and blunt, not forming a free flap in the

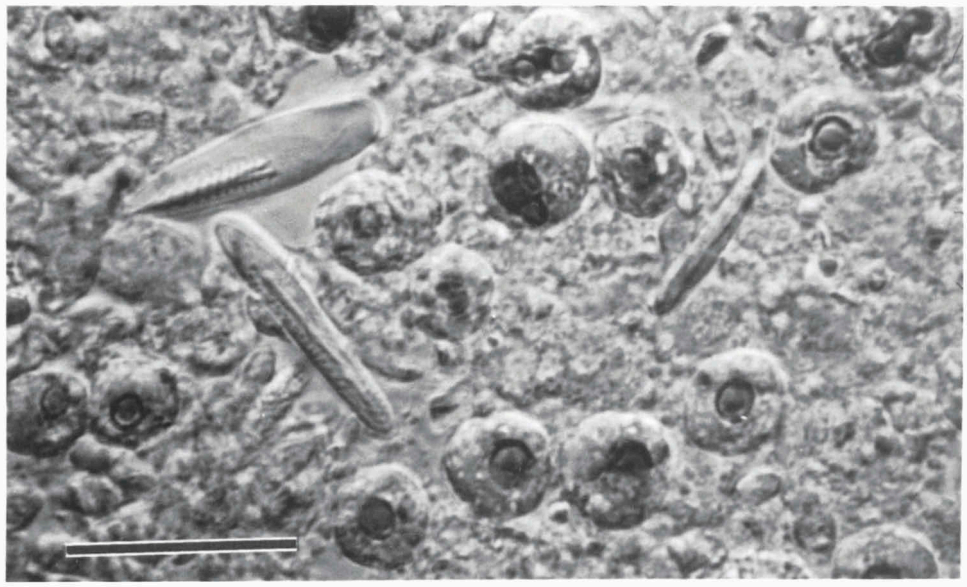


Fig. 37. *Synantheopsis parulekari* spec. nov. Squash preparation of distal, trilobed filamental cord with nematocysts (spirulae and penicillus A) and zooxanthellae (RMNH Coel. 18427). Scale bar 20 µm.

lower part of the body. Basilar muscles weak. Zooxanthellae rather common in the distalmost parts of the filaments (fig. 37) and in sparse numbers in the endoderm of tentacles and oral disc.

Remark: In the specimen from Thailand the distalmost region seems to show signs of degeneration. The tentacles, the verrucae and the marginal sphincter are obviously abnormally reduced in size (fig. 34). In spite of this abnormal condition there is no doubt about the conspecificity of this specimen with those from India.

Cnidom (table 3, figs. 37-38).— For a detailed survey of the cnidom see table 3 and fig. 38.

Table 3 (cf. fig. 38). *Synantheopsis parulekari* spec. nov., survey of the cnidom of the three specimens of the type series. A = holotype (RMNH Coel. 18426); B = paratype from India (RMNH Coel. 18427); C = paratype from Thailand (RMNH Coel. 18440). For the codes on frequency see "Remark" on p. 602.

| Organ | Nematocyst type | Specimen | Average and range (in parentheses) of length and width of nematocyst capsules in µm | N | Frequency |
|---|---|---|---|---|---|
| 1. Base | a. Spirulae | A | 7.6(6.2 - 8.5) × 1.8(1.8 - 2.0) | 6 | - - - |
| | | B | 7.3(6.7 - 8.0) × 1.9(1.8 - 2.0) | 10 | - |
| | | C | 7.8(7.1 - 8.9) × 1.9(1.8 - 2.3) | 20 | - - /- |
| | b. Spirulae | A | 15.0(13.5 - 16.2) × 2.2(2.0 - 2.3) | 20 | + |
| | | A | 14.9(14.2 - 16.9) × 2.3(2.0 - 2.4) | 20 | + |
| | | B | 15.0(14.2 - 16.0) × 2.4(2.2 - 2.7) | 20 | + |
| 2. Column [proximally] | a. Spirulae | A | 8.4(7.7 - 9.0) × ca. 1.5 - 1.8 | 20 | - |
| | | B | 7.2(6.2 - 8.5) × 1.8(1.8 - 2.0) | 20 | + |
| | | C | 7.4(6.7 - 8.0) × 1.9(1.8 - 2.0) | 10 | - |
| | b. Spirulae | A | 17.2(14.4 - 18.5) × 2.3(2.3 - 2.5) | 30 | ++ |
| | | B | 15.6(13.4 - 18.7) × 2.4(2.2 - 2.7) | 30 | ++ |
| | | C | 15.8(14.2 - 16.9) × 2.5(2.3 - 2.7) | 20 | + |
| [distally] | a. Spirulae | A | 7.2(6.7 - 8.0) × ca. 1.7 | 10 | - - - |
| | | B | 6.9(6.2 - 7.1) × 1.8(1.8 - 2.0) | 10 | - - |
| | | C | 6.9(6.2 - 8.0) × 1.9(1.8 - 2.3) | 20 | -/+ |
| | b. Spirulae | A | 15.2(14.4 - 16.2) × ca. 2.0 | 30 | ++ |
| | | B | 13.3(11.6 - 15.1) × 2.2(2.0 - 2.4) | 40 | ++ |
| | | C | 14.6(13.4 - 16.0) × 2.3(2.2 - 2.7) | 20 | +/++ |
| 3. "Pseudo-acrorhagi" | a. Spirulae | A | 14.2(12.0 - 15.1) × 1.8(1.8 - 2.0) | 30 | +++ |
| | | B | 13.0(12.0 - 13.8) × 1.9(1.8 - 2.0) | 20 | ++ |
| | | C | 13.3(10.7 - 15.1) × 2.1(1.8 - 2.3) | 20 | ++ |
| 4. Tentacle tips | a. Spirocysts | A | ca. 15 - 32.5 × 2.5 - 3.8 | — | ++ |
| | | B | ca. 15 - 32 × 2.3 - 3.6 | — | ++ |
| | | C | ca. 16 - 30 × 2.7 - 4.0 | — | +/++ |
| | b. Spirulae | A | 12.9(11.7 - 14.0) × 2.0(1.8 - 2.3) | 20 | - |
| | | B | 12.2(9.9 - 14.4) × 1.8(1.6 - 2.0) | 10 | - [inc.] |
| | | C | Included in range of next category | — | — |
| | c. Spirulae | A | 19.3(17.1 - 21.6) × 2.2(2.0 - 2.3) | 20 | ++ |
| | | B | 20.8(19.8 - 22.5) × 2.3(2.3 -2.5) | 20 | ++ |
| | | C | 16.7(11.6 - 20.9) × 2.4(2.0 - 2.7) | 45 | ++/+++ |
| 5. Stomodaeum | a. Spirocysts | A | 31.7(24.0 - 35.6) × 4.3(3.6 - 4.9) | 20 | - -/+ |
| | | B | ca. 23 - 31.5 × 3.6 - 4.5 | — | - - ? |
| | | C | 33.4(28.5 - 36.5) × 5.3(4.5 - 6.2) | 20 | +/++ |

| | | | | | |
|---|---|---|---|---|---|
| | b. Spirulae | A | 15.7(14.4 - 16.7) × 2.0(1.8 - 2.0) | 10 | - |
| | | B | 12.9(11.7 - 14.4) × 2.0 | 10 | + |
| | | C | 13.4(12.0 - 14.7) × 2.0(1.8 - 2.2) | 20 | --/- |
| | c. Spirulae | A | 22.8(20.7 - 25.2) × 3.4(3.2 - 3.6) | 30 | ++ |
| | | B | 22.7(20.7 - 23.9) × 3.4(3.2 - 3.6) | 20 | ++ |
| | | C | 23.7(22.3 - 25.8) × 3.5(3.1 - 3,8) | 30 | ++ |
| | d. Penicilli A | A | 26.6(24.9 - 27.6) × 5.5(5.1 - 6.2) | 20 | -- |
| | | B | 22.0(20.7 - 24.3) × 5.2(4.5 - 5.9) | 20 | - |
| | | C | 25.4(22.7 - 28.5) × 5.4(4.9 - 6.2) | 12 | --- |
| Filaments [trilobed] | a. Spirocysts | A | ca. 21.5 - 31.0 × 3.3 - 4.5 | — | -/+ |
| | | B | ca. 19.0 - 28.5 × 3.3 - 4.9 | — | +/++ |
| | | C | 20.5 - 28.5 × 3.6 - 5.4 | — | - |
| | b. Spirulae | A | 13.4(12.0 - 15.1) × 1.8(1.8 - 2.0) | 20 | +/++ |
| | | B | 13.1(12.0 - 15.1) × 1.8(1.8 - 2.0) | 20 | +/++ |
| | | C | 11.8(9.8 - 13.4) × 1.9(1.8 - 2.0) | 20 | +/++ |
| | c. Spirulae | A | 21.8(19.6 - 24.9) × 3.1(2.9 - 3.3) | 20 | + |
| | | B | 20.9(19.6 - 23.1) × 3.2(2.7 - 3.6) | 20 | +/++ |
| | | C | 20.7(16.9 - 21.4) × 3.2(2.7 - 3.6) | 20 | +/++ |
| | d. Penicilli A | A | 25.7(23.1 - 29.4) × 5.4(4.9 - 6.7) | 10 | -- |
| | | B | 23.4(20.5 - 28.5) × 6.1(4.5 - 7.6) | 20 | +/++ |
| | | C | 24.3(22.3 - 29.4) × 5.7(4.9 - 7.1) | 12 | +/++ |
| 6. Filaments [unilobed] | a. Spirulae | A | 13.8(13.1 - 15.3) × 2.0 | 25 | ++ |
| | | B | 13.2(11.7 - 15.3) × 2.0(1.8 - 2.3) | 20 | + |
| | | C | 12.3(11.6 - 13.4) × 2.0(1.8 - 2.2) | 20 | + |
| | b. Spirulae | A | 32.0(30.6 - 36.9) × 4.0(3.6 - 4.5) | 25 | + |
| | | B | 29.6(27.0 - 31.5) × 4.0(3.6 - 4.5) | 20 | + |
| | | C | 33.3(29.4 - 36.5) × 4.3(4.0 - 5.3) | 40 | + |
| | c. Penicilli A | A | 25.8(23.4 - 27.0) × 5.3(4.5 - 6.3) | 25 | ++ |
| | | B | 23.9(22.5 - 25.2) × 5.6(5.0 - 6.3) | 20 | ++ |
| | | C | 25.0(23.1 - 26.7) × 5.3(4.7 - 5.8) | 30 | +/++ |
| | d. Penicilli $B_1$ | A | 19.2(17.6 - 22.5) × 2.9(2.7 - 3.2) | 25 | -/+ |
| | | B | 16.6(15.3 - 18.0) × 3.3(3.2 - 3.6) | 20 | -/+ |
| | | C | 18.4(17.8 - 19.6) × 3.2(2.9 - 3.6) | 20 | -/+ |

The nematocyst categories occurring in the stomodaeum and the trilobed distal part of the filaments are identical but there are differences in frequency. The distribution of spirocysts in the stomodaeum is mainly restricted to its lower part. The cnidom of the present species is very similar to that of *Synantheopsis primus* England, 1992 (:81).

Habitat— All three specimens were collected on a tidal flat, burrowing in sand or sandy mud.

Distribution (fig. 39).— Exclusively known from Okha, Gulf of Kutch, Gujarat coast (type locality) and Bombay (Parulekar, 1968: 143; as *Actinogeton sultana* (Carlgren, 1900)), both India, and Ko Libong, Trang Province, Thailand, on the west side of the Malay Peninsula.

Discussion.— England (1992), in a posthumous paper, described a new monotypic genus *Synantheopsis* to include *S. primus* England, 1922, from Hong Kong, which, in spite of looking quite different at first sight, resembles the present species in many respects. The two species definitely belong in the same genus. They share the presence of (1) a weak, restricted to distinctly circumscript sphincter, (2) the more or less elongate body with distinct verrucae in the uppermost part, and (3) an identical cnidom (both as regards types and size classes of nematocysts). The difference between the two species concerns the number of tentacles and mesentery cycles. In

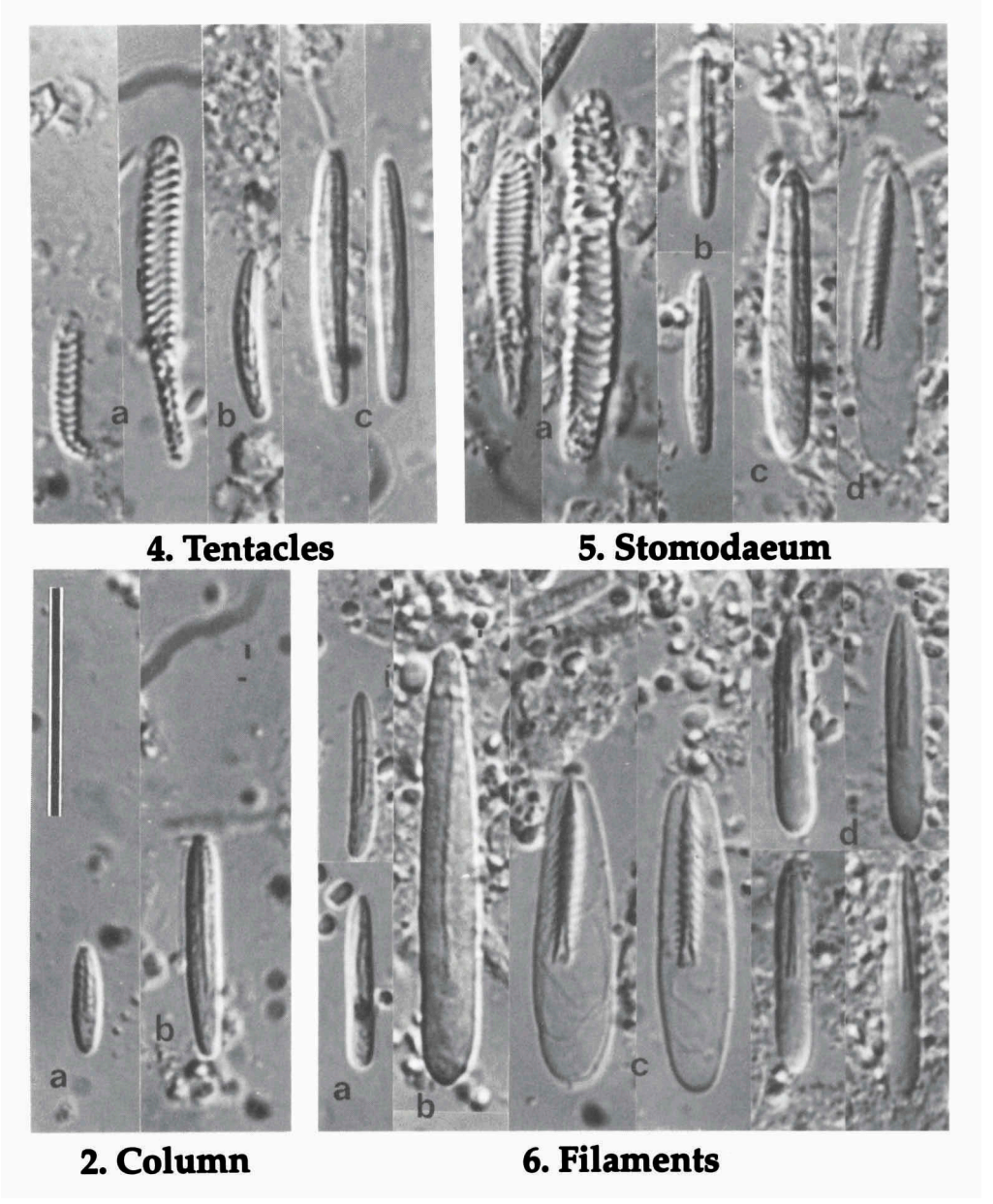



Fig. 38. *Synantheopsis parulekari* spec. nov. Pictorial survey of the cnidom of the holotype from Okha, India (RMNH Coel. 18426). Figures and characters correspond to those in table 3. Scale bar 20 µm.
**2. Column**: a. Spirula; b. Spirula. **4. Tentacle tips**: a. Spirocysts; b. Spirula; c. Spirulae. **5. Stomodaeum and trilobed filaments**: a. Spirocysts; b. Spirulae; c. Spirula; d. Penicillus A. 6. **[Unilobed] Filaments**: a. Spirulae; b. Spirula; c. Penicilli A; d. Penicilli $B_1$.

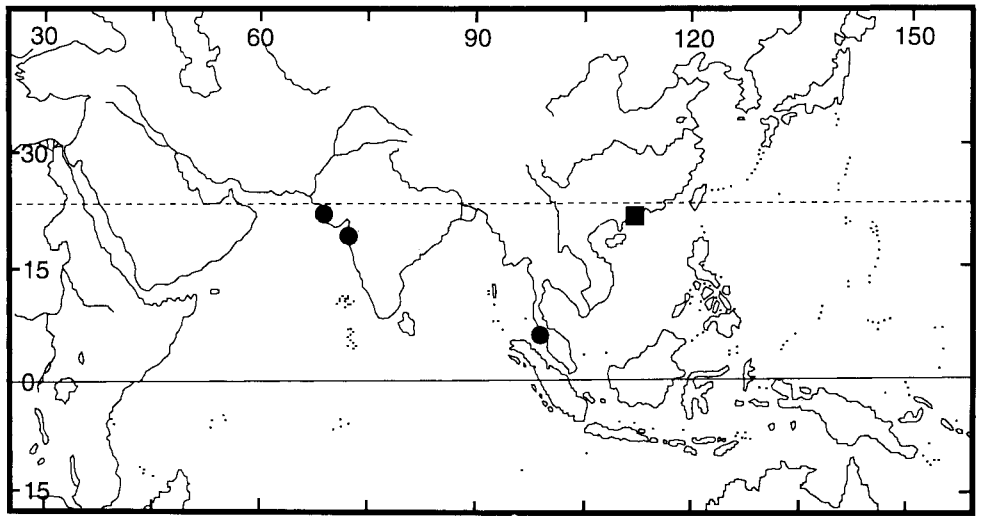



Fig. 39. Known distribution of the genus *Synantheopsis* England, 1992. Dots: *S. parulekari* spec. nov. (including record of *Actinogeton sultane* by Parulekar, 1968). Square: *S. primus* England, 1992.

*S. primus* there are 96 tentacles and 48 mesentery pairs, including three perfect, fertile cycles and one almost microcnemic cycle with small filaments in the upper region. The specimens from India and Thailand each have ca. 384 tentacles and 96-192 mesenteries arranged in 5-6 cycles, four of which are perfect and fertile, whereas the mesenteries of the fifth cycle are almost microcnemic, with poorly developed trilobed filaments only along their distalmost edge. The sixth cycle, when present, is only indicated and completely without filaments. England did not record the presence of zooxanthellae in *Synantheopsis primus*, but it appears that he overlooked them; a reexamination of the holotype convincingly showed them to be present (staining with Meltzer's reagens). In conclusion the two species are very similar and it even seems possible that England's specimen of *S. primus* represents an immature specimen of the present species. However, mainly based on the fact that it is sexually mature in spite of its low number of mesenteries and tentacles (48 versus 96-192 mesentery pairs and 96 versus about 384 tentacles), we describe the latter as a new species, although with some hesitation because too little is in fact known about the relation between morphological development and sexual maturity in Actiniaria. Future collecting of additional specimens (including colour notes), both from India and Hong Kong, may help to solve this problem. In view of the fact that, due to sea level fluctuations in the Pliocene-Pleistocene era, the Malay Peninsula and the islands on the Sunda Plat formed a continuous land mass during considerable periods of time and possibly a significant dispersal barrier for marine organisms, it is note-worthy that the specimen of *S. primus* originates from east of the Malay Peninsula, whereas those of *S. parulekari* are from west of it.

The record of *Actinogeton sultana* by Parulekar (1968: 143, pl. 2 fig. 11) also bears upon the present species. His descriptive notes and figure (even if somewhat schematic), as well as his later reference to the burrowing habits of the species (Parulekar, 1990: 226) leave no doubt about this.

Etymology.— The specific epithet alludes to Dr. A. Parulekar, NIO, Goa, India, who was the first to make reference of specimens of this species (as *Actinogeton sultana*; see above).

## **Paracondylactis** Carlgren, 1934
## **Paracondylactis** cf. **sinensis** Carlgren, 1934
## (figs. 40-41)

*Paracondylactis sinensis* Carlgren, 1934: 26-28, fig.15 (Jangtszekiang, Swatau); 1949: 55.
*Paracondylactis dawydoffi* Carlgren, 1943: 27-28, figs. 17-18 (Cochinchina, Poulo Condore).
*Paracondylactis davydoffi*; Carlgren, 1949: 55 [misspelling].
*Paracondylactis indicus* Parulekar, 1966: 38,40 table 1 (cnidom); 1968: 143, 145, pl. 2 fig. 10 (descriptive notes; India, Bombay); 1990: 219, 221, 223 tab.1, 226 tab. 2.
*Paraconodylactis indicus*; Hague, 1977: 36, 39 (Bangladesh, East Bengal) [misspelling].
*Paracondylactis sagarensis* Parulekar, 1990: 223, 226 (Sagar Island, West Bengal) [apparently a nomen nudum, see discussion].
*Paracondylactis sp.*; Misra 1975: 46-47; 1984: 195-196, pl. 8 (Sagar Island and Digha Coast, West Bengal).
*Gyrostoma* sp.; Menon, 1927: 36-37, pl. 7 fig. 7 (colour; India, Gulf of Manaar) [in part].

Material.— RMNH Coel. 18432 (India, W coast, Goa, Cabo de Rona, 1989, 1 specimen with base and lower part of column ripped off); RMNH Coel. 18433 (India, W coast, Maharashtra, Ratnigiri, Malvan, intertidal, burrowing in sand, iii-v.1989, 1 specimen).

Material examined for comparison.— **Continental China**: ZMS 1195 [type coll. 4005] (syntype *P. sinensis* Carlgren, 1934; Swatau, 45 fms); ZMS 1291 [type coll. 4006] (idem; Jangtzekiang, Schönau, 6.5 fms).— **China, Hainan**: Collection Institute of Oceanologia, Academica Sinica, Qingdao (Paigang, Qinglan, intertidal, in muddy bottom, 12.xi.1990, 1 large specimen, leg. Dr. Z. Tang); RMNH Coel. 18714 (Qinglan, intertidal, muddy bottom, 7.xi.1990, 1 specimen, leg. Dr. Z. Tang no. 90-Ce-015); SMF. s. n. (Shalao, intertidal, muddy bottom, 7.xi.1990, 1 specimen, leg. Dr. Z. Tang no. 90-Ce-016).— **Philippines**: RMNH Coel. 3799 (Manila Bay, on or below the tideline, xii.1922, 1 specimen, Univ. of Phil. Dep. of Zool., P.B. Sickvis); RMNH Coel. 3800 (idem, without date).— **Vietnam**: ZMS 1304 [type coll. 4008] (holotype *P. dawydoffi* Carlgren, 1943; Poulo Condore, leg. Dawydoff).— **Moçambique**: RMNH Coel. 18451 (Ilha da Inhaca, Ponta Raza, sandy intertidal, 1.xi.1986, 1 specimen leg. J.H.C. Walenkamp); RMNH Coel. 18543 (Ilha da Inhaca, N coast of Ilha dos Portugueses, beach, 16.i.1987, 1 specimen; don. J.H.C. Walenkamp); RMNH Coel. 18454 (Inhaca Island, S of Ponta Punduini, in intertidal sand flat, 27.vii.1982; leg. J.H.C. Walenkamp).

Morphology.— Lower part of column rather contracted and base slightly inverted in the small complete specimen (size ca. 4 × 3.5 cm) from Maharashtra, ripped off and absent in the larger specimen (size ca. 5.5 × 3.5 cm) from Goa. Column smooth and without defined nematocyst batteries or other specialized structures, with the exception of a single row of 24 and 48 perforated pseudo-acrorhagi, respectively, situated on the parapet and corresponding with the endocoelic tentacles. Perforations, one per pseudo-acrorhagus, visible under low magnification as small papillae, notably in the small specimen. Oral disc in the small specimen well expanded, revealing 96 rather short, acute tentacles, hexamerously arranged in five cycles. Oral disc of the larger specimen withdrawn, also with 96 rather short tentacles.

Colour.— No data with the present material. Previous authors gave the following information: column light cream, occasionally red, tentacles colourless, disc sometimes bluish (Menon, 1927: 36); column reddish orange with tentacles and oral disc white to colourless (Parulekar, 1968: 143); column reddish orange to light yellowish,

tentacles and oral disc light yellow, opaque-white to colourless (Hague, 1977: 39).

Anatomy.— Not studied in detail due to the condition of the material. In the larger, incomplete, specimen from Maharashtra the circular muscle layer is well-developed, especially in the distal part of the column, merging via a slight interruption (due to the presence of pseudo-acrorhagi) into a diffuse sphincter (corresponding to the fossa) which is hardly stronger than the rest of the circular muscle layer. In both specimens the directive mesenteries are connected with two pronounced siphonoglyphs extending aborally from the stomodaeum as distinct, long, smooth slips. The small specimen is sterile and apparently not fully developed. It is provided with 24 pairs of perfect mesenteries arranged in three cycles extending over the entire length of the column. In the distal part of the body there is an additional fourth cycle of tiny imperfect mesenteries with trilobed filamental cord only, connected with the distalmost part of the inner column-wall and the oral disc. In the larger, incomplete specimen there are four cycles of perfect mesenteries (i.e. 48 pairs), all fertile and provided with well-developed gonads and extending over the entire length of the (available part of the) body. However, as the proximal part of the body has been ripped of above the level of the free edge of the directive mesenteries, it is impossible to provide information on the gonads of the directives. In both specimens the diffuse retractors form a broad band of about uniform thickness of numerous parallel, equally long, unbranched to slightly branched muscle processes.

Cnidom (tables 4, 5; fig. 40).— A survey of the cnidom of the two Indian specimens studied is presented in table 4 and fig. 40.

Table 4 (cf. fig. 40). *Paracondylactis sinensis* Carlgren, 1934. Survey of the cnidom of two specimens from India (A = RMNH Coel. 18433; B = RMNH Coel. 18432). Asterisk (*) indicates that measurements relate to the middle part of the column in the absence of the lower part. For the codes on frequency see "Remark" on p. 602.

| Organ | Nematocyst type | Specimen | Average and range (in parentheses) of length and width of nematocyst capsules in µm | N | Frequency |
|---|---|---|---|---|---|
| 1. Base | a. Spirulae | A | 16.0(13.1 - 19.8) × 2.5(2.3 - 2.7) | 30 | ++ |
| | | B | base absent, no data | — | — |
| 2. Column - [proximally] | a. Spirulae | A | 10.9(9.0 - 12.6) × 2.0 | 7 | - - - |
| | | B* | not observed | | |
| | b. Spirulae | A | 18.3(13.1 - 22.5) × 2.8(2.3 - 3.4) | 60 | ++ |
| | | B* | 16.0(13.5 - 19.4) × 2.5(2.3 - 2.7) | 45 | + |
| | c. Penicilli A | A | not observed | — | — |
| | | B* | 18.8(17.1 - 20.7) × 5.2(4.5 - 5.9) | 20 | — |
| Column [distally] | a. Spirulae | A | ca. 9 - 12 × 2 | — | - - - |
| | | B | not observed | — | — |
| | b. Spirulae | A | 15.5(13.7 - 20.7) × 2.4(2.3 - 2.7) | 60 | ++ |
| | | B | 14.7(11.7 - 17.1) × 2.5(2.3 - 2.7) | 30 | + |
| | c. Penicilli A | A | not observed | — | — |
| | | B | 18.4(16.7 - 21.6) × 5.3(4.5 - 5.9) | 30 | + |
| 3. Pseudo-acrorhagi | a. Spirulae | A | 13.5(11.7 - 15.3) × 2.3 | 20 | ++ |
| | | B | 13.8(12.6 - 15.8) × 2.4(2.3 - 2.7) | 20 | ++ |
| | b. Penicilli A | A | not observed | — | — |
| | | B | 17.1 × 5.0 | 1 | - - - |

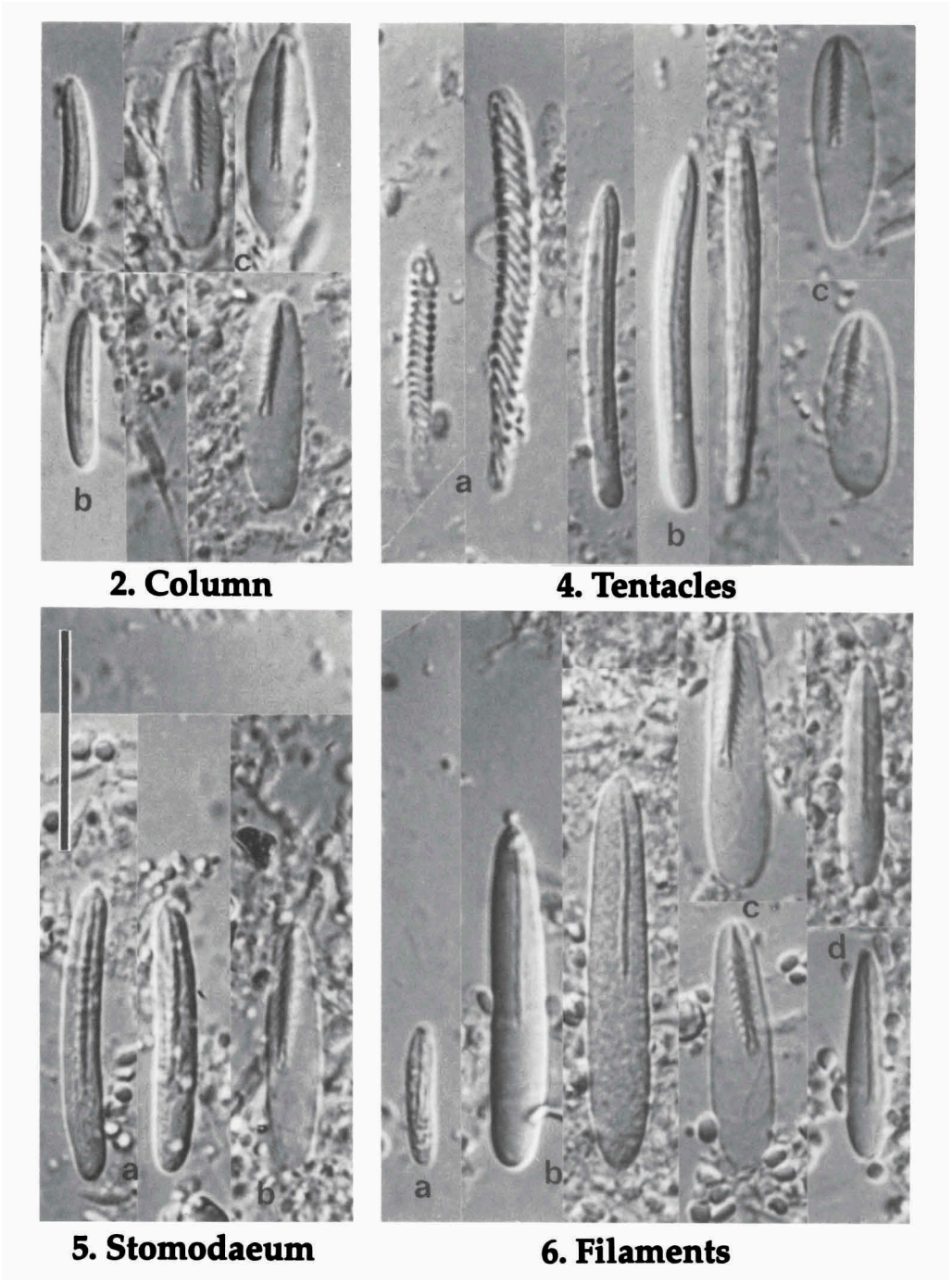



Fig. 40. *Paracondylactis* cf. *sinensis* Carlgren, 1934. Pictorial survey of the cnidom of a specimen from Goa, India (RMNH Coel. 18432). Figures and characters correspond to those in table 4. Scale bar = 20 µm.

**2. Column**: b. Spirulae; c. Penicilli A. **4. Tentacle tips**: a. Spirocysts; b. Spirulae; c. Penicilli A. **5. Stomodaeum**: a. Spirulae; b. Penicillus A. **6. Filaments**: a. Spirula; b. Spirulae; c. Penicilli A; d. Penicilli $B_1$.

| | | | | | |
|---|---|---|---|---|---|
| 4. Tentacle tips | a. Spirocysts | A | ca. 17.0 - 15.3 × 2.5 - 4.0 | — | +++ |
| | | B | ca. 18.0 - 40.0 × 2.2- 3.6 | — | +++ |
| | b. Spirulae | A | 27.0(23.4 - 29.7) × 2.5(2.3 - 2.7) | 20 | +++ |
| | | B | 31.5(26.1 - 36.9) × 2.5(2.5 - 2.7) | 50 | ++ |
| | c. Penicilli A | A | 16.1(14.4 - 18.0) × 4.2(3.6 - 4.7) | 20 | --- |
| | | B | 18.8(15.8 - 20.7) × 5.0(4.5 - 5.6) | 20 | -- |
| 5. Stomodaeum | a. Spirulae | A | 23.1(20.7 - 25.2) × 3.4(3.2 - 3.6) | 30 | ++ |
| | | B | 25.9(23.4 - 27.9) × 3.3(3.2 - 3.6) | 20 | ++ |
| | b. Penicilli A | A | 19.4(17.1 - 21.6) × 5.2(4.5 - 5.9) | 20 | + |
| | | B | 24.4(23.5 - 26.1) × 5.1(4.5 - 5.4) | 7 | -- |
| 6. Filaments | a. Spirulae | A | 11.2(9.9 - 12.6) × 2.2(2.0 - 2.5) | 20 | + |
| | | B | 12.2(10.4 - 13.5) × 2.4(2.0 - 2.7) | 20 | - |
| | b. Spirulae | A | 30.8(23.9 - 36.0) × 4.9(4.1 - 6.1) | 40 | -/+ |
| | | B | 33.1(28.4 - 36.9) × 5.2(4.5 - 5.9) | 20 | -/+ |
| | c. Penicilli A | A | 20.4(18.9 - 22.1) × 5.3(5.0 - 5.9) | 20 | ++ |
| | | B | 23.7(21.6 - 26.1) × 5.0(4.5 - 5.9) | 20 | +/++ |
| | d. Penicilli $B_1$ | A | 18.4(16.2 - 20.7) × 3.4(3.2 - 3.8) | 20 | -- |
| | | B | 19.2(17.6 - 21.2) × 3.6 | 10 | --- |

It is interesting to note that the cnidom of the tentacle tips of both specimens includes the sporadic to rare presence of penicilli A. This nematocyst type was also found in the column of the specimen from Goa (even not uncommon distally), but not in the larger specimen from Maharashtra. Less detailed previous surveys of the cnidom of species of *Paracondylactis* do not make mention of the presence of these penicilli A, but a comparative study of material from other localities (continental China and Hainan Island, Philippines and Moçambique) revealed their sporadic presence in the tentacle tips and/or the column of several other specimens (table 5). Also noticeable is the rare to sporadic presence of penicilli $B_1$ in the filaments (not convincingly confirmed in other specimens) and the fact that the size (average and range) of the columnar spirulae increases from the margin (pseudo-acrorhagi) towards the base. This latter phenomenon was confirmed in all specimens studied for comparison.

Table 5. *Paracondylactis* cf. *sinensis* Carlgren, 1934, presence of penicilli A in tentacle tips and columnar ectoderm of 11 specimens examined; + = sporadically present (even not uncommon in the specimen from Goa); - = not observed.

| Specimen/Museum number | Locality | Tentacle tips | Column |
|---|---|---|---|
| ZMS 1195 (syntype *P. sinensis*) | China, Swatau | + | + |
| ZMS 1291 (syntype *P. sinensis*) | China, Schönau | - | - |
| RMNH Coel. 18714 | China, Hainan | + | - |
| SMF s.n. | China, Hainan | - | + |
| Collection Qingdao | China, Hainan | + | - |
| ZMS 1304 (holotype *S. dawydoffi*) | Vietnam, Poulo Condore | + | + |
| RMNH Coel. 3799 | Philippines, Manila Bay | + | - |
| RMNH Coel. 3800 | Philippines, Manila Bay | + | - |
| RMNH Coel. 18432 | India, Goa | + | - |
| RMNH Coel. 18433 | India, Maharashtra | + | + |
| RMNH Coel. 18451 | Moçambique, Inhaca | - | - |
| RMNH Coel. 18453 | Moçambique, Inhaca | - | - |
| RMNH Coel. 18455 | Moçambique, Inhaca | - | - |

Discussion.— Carlgren (1949: 55) recognized three species of *Paracondylactis*, viz. *P. hertwigi* (Wassilieff, 1908) (see also Carlgren, 1934: 23-26, fig. 14; Japan, China), *P. sinensis* Carlgren, 1934 (China) and *P. dawydoffi* Carlgren, 1943 (Poulo Condore = Con Son, South Vietnam). Although the descriptions of these species are rather incomplete, it is beyond doubt that *Paracondylactis hertwigi* is a distinct species. It is characterized by 48 tentacles, 24 mesentery pairs, relatively small spirulae in the tentacles, and the arrangement of the spirulae in the column in special batteries. The other two species share the presence of 96 tentacles, 48 mesentery pairs, larger spirulae in the tentacle tips, and the absence of special nematocyst batteries in the column. However, according to Carlgren (1934: 26; 1943: 27), the sphincter in *P. sinensis* is distinct, though not very strong, whereas only indicated in the holotype of *P. dawydoffi*; he also noted a difference in size in the columnar spirulae, those in *P. dawydoffi* being somewhat larger. We are inclined to regard the difference in development of the sphincters as individual variation. Considerable variation of this muscle is not uncommon among Actiniaria. England (1992: 81 fig. 14), e.g., showed the structure of the sphincter of *Synantheopsis primus* (another burrowing species) to vary from diffuse to more or less circumscript in a single individual. As to the size of the columnar spirulae: the present study of Indian material supplemented with a preliminary study of material from Hainan, the Philippines and Moçambique has shown that there are two size-classes of spirulae in the column, and that those of the largest category increase significantly in size from the margin to the base. Thus, to avoid bias, it is necessary to compare nematocyst measurements from corresponding levels of the column. Even so, the present study, which included a re-examination of the holotype of *P. dawydoffi* and of two (poorly preserved) specimens from the type series of *P. sinensis*, showed the variation in size in different specimens to be considerable. In our view all these specimens are nonetheless basically similar, presumably belonging to a single species; but a more detailed study of the anatomy and the cnidom, preferably of a larger material, is necessary for a decisive conclus-ion. Therefore, pending such a study, we refer to this species as *Paracondylactis* cf. *sinensis* Carlgren, 1934 (the oldest synonym).

Specimens from the west coast of India (Bombay region) were previously described as *P. indicus* by Dave (1957) in an unpublished MSc thesis, and this name was made available by Parulekar (1966: 40) who published some measurements of cnidae, which (although unintentionally so) happen to constitute an official description. However, these measurements, as well as additional notes published later on (Parulekar, 1968: 143), though leaving no doubt about the generic identity, are too incomplete to allow a comparison with other species. Efforts to obtain Dave's thesis and the specimens on which the original description was based, failed. Nevertheless, there is all reason to assume that the specimens from Goa and Maharashtra examined by us belong to the same species studied by Dave and Parulekar. Considering that these specimens cannot positively be separated from *P. sinensis* on the basis of available information on morphology, anatomy and cnidom, we regard *P. indicus* Parulekar, 1966, as a subjective junior synonym of *P. sinensis* Carlgren, 1934.

One more species of *Paracondylactis*, viz. *P. sagarensis* Bhattacharya, 1979, from Sagar Island, West Bengal, was included by Parulekar (1990: 219, 223, 226) in a list of sea anemones from India, but the reference to this paper was omitted from the literature cited. As we did not succeed in tracing Bhattacharya's original description in the

official literature (it is not included in the Zoological Record), we assume that the name *P. sagarensis* was taken from an unpublished thesis and is not an available name. As Parulekar's subsequent use of the name is not accompanied by a description or definition, it presumably constitutes a nomen nudum. Previous records of a "giant variety of sea anemone, *Paracondylactis* sp." from Sagar Island and the Digha coast of the Gangetic delta, West Bengal) (Misra, 1975; 1984) and of *P. indicus* from Cox's Bazar coast, eastern Gangetic delta (Hague, 1977: 39), do not contain information suggesting that the species occurring in the Gangetic delta differs from the one found in the rest of India.

Biological notes.— A burrowing species found in muddy or sandy bottoms, often intertidally. Live, well-developed specimens in situ may reach a length amply exceeding 0.5 m (personal communication Dr. Z. Tang, Qingdao, P.R. of China); size indications given in the literature are: Menon, 1927 (largest specimen 300 mm in length); Parulekar, 1968 (60-500 mm); Hague, 1977 (60-500 mm) and Misra, 1975 ("..the best way of collecting this sea anaemone [sic] is to dig the soil 25-30 cm around a specimen up to a depth of about 60-120 cm depending on the size of the anemone.."). Parulekar (1968), with reference to the Bombay region of the Indian

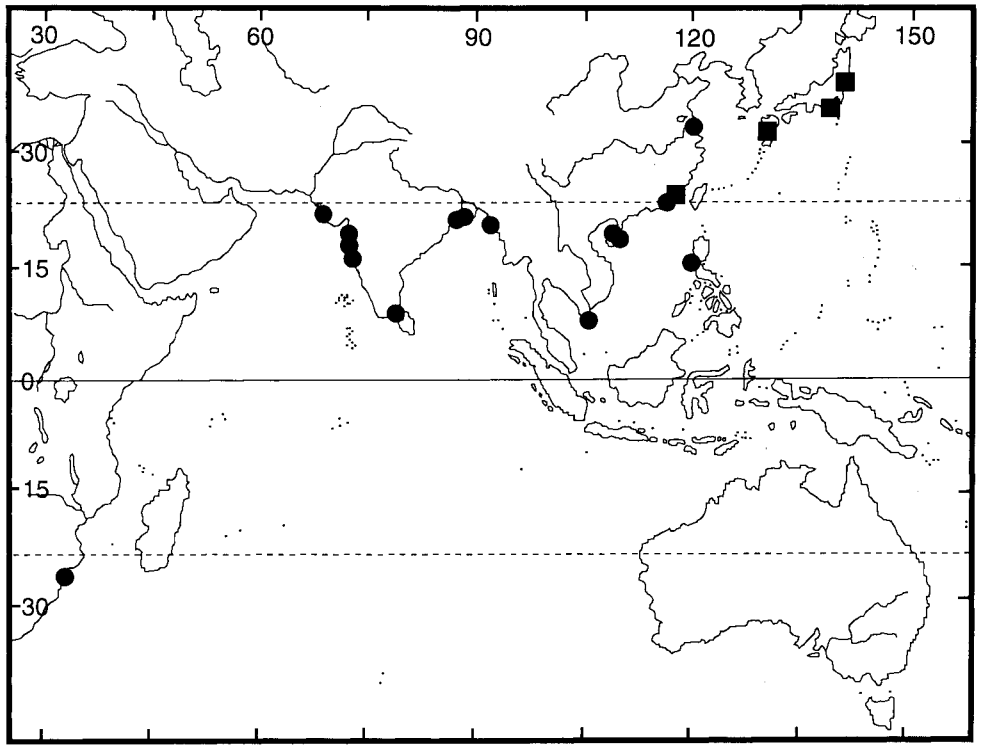



Fig. 41. Known distribution of the genus *Paracondylactis* Carlgren, 1934. Dots: *P.* cf. *sinensis*, Carlgren, 1934. Squares: *P. hertwigi* (Wassilieff, 1908).
Sources *P.* cf. *sinensis*: Menon, 1927; Carlgren, 1934, 1943; Parulekar, 1968, 1990; Misra, 1975, 1984; Hague, 1977; unpublished records from RMNH collection (India, Philippines, Moçambique) and collection Dr. Tang Zhican, Qingdao, P.R. China (Hainan). Sources *P. hertwigi*: Wassilieff, 1908; Carlgren, 1934 (excluding "specimen A" from Jangtzekiang which seems referable to *Neocondylactis singaporensis* England, 1987).

west coast, mentioned that the species is usually found associated with the crab *Thalamita crenata* (Latreille, 1829).

Distribution (fig. 41).— So far *Paracondylactis sinensis* was exclusively known from the type collection (Carlgren, 1934) (eastern China). Subject to what has been said above under "Discussion", the present records from India, the Philippines, Hainan and Moçambique, as well as the accepted synonymy of the species with *P. dawydoffi* and *P. indicus*, considerably extend the known range of the species.

Further notes.— *Paracondylactis hertwigi* Wassilieff, 1908 (the type species) from Japan (type locality Honshu, Suruga Bay) and northern China (Carlgren, 1943) (fig. 41) has also been reported from Brazil (Corrêa & Schlenz, 1976), but this record appears to be based on a misidentification to be dealt with in a future paper.

## Family Stichodactylidae Andres, 1883

### **Stichodactyla** Brandt, 1835
### **Stichodactyla haddoni** (Saville-Kent, 1893)
### (figs. 42-47)

*Stoichactis gigantium*; Trivedi, 1974: 387 (Mithapur, Okha-Dwarka area, Gujarat) [misspelling].
*Stoichactis giganteum*; Menon, 1927: 38 (Gulf of Manaar) Nayar & Mahadevan, 1967: 458 (Off Tuticorin, Gulf of Mannar); Trivedi, 1977: 444-445 (Mithapur and Okha coast of Gujarat).

For the further synonymy of this species, see Dunn, 1981: 82.

Material.— RMNH Coel. 18431 (Okha, Gujarat coast, 1 specimen ; no further data, probably collected by Dr Y. Kamat in the 1980's).

Material examined for comparison.— **Indonesia**: RMNH Coel. 18441 (Rumphius Biohistorical expedition 1990, sta. 37, Moluccas, Ambon, Ambon Bay, Hitu, W side of Laha, 6.xii.1990, depth 15 m, 2 specimens, leg. C.H.J.M. Fransen & J. van Egmond).— **Thailand**: RMNH Coel. 18444 (Trang Province, Ko Libong, Ban Patu Puk, low sandy mud flat, 1 small specimen, leg. C. Swennen).— **Moçambique**: RMNH Coel. 18443 (Ilha da Inhaca, 200 m from Ponta Punduini, 15.i.1987; leg. Maria Perpétua (D406), 2 specimens).

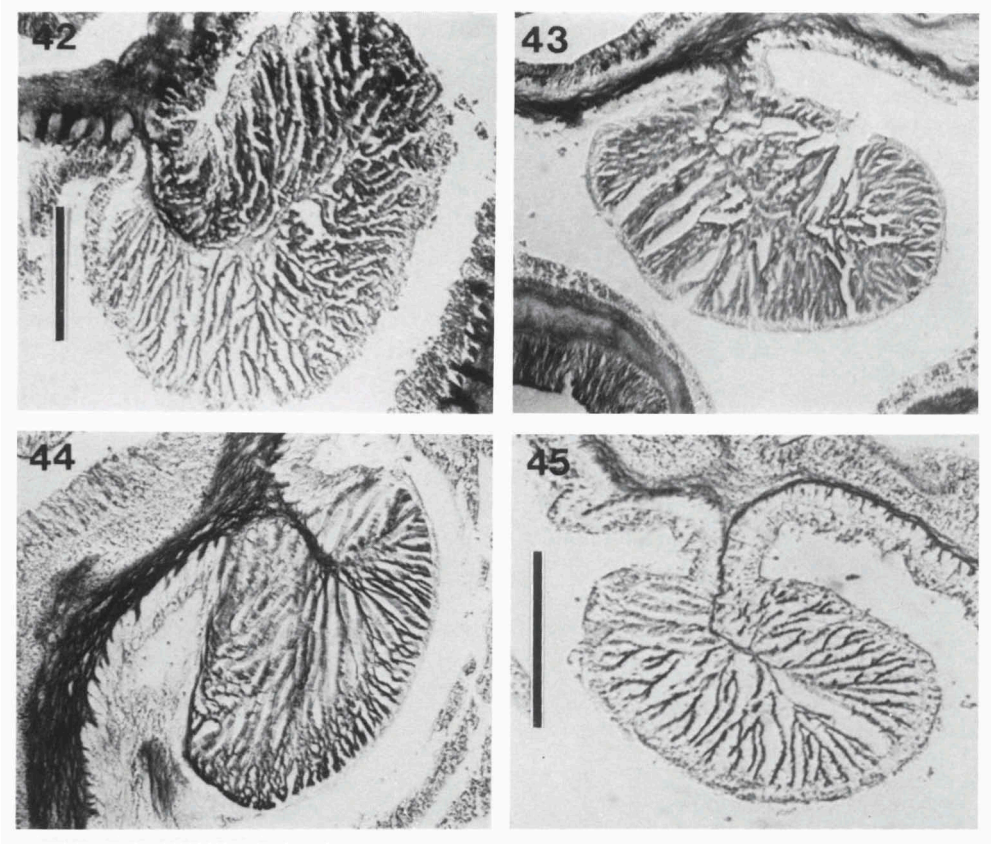
Morphology.— The single specimen is badly preserved (in alcohol), the ectodermal tissues of column, base and tentacles being rather macerated and tending to slough off.

Base semicircular, ca. 8 × 9 cm in cross-section. Column strongly retracted, provided with numerous circular folds, widely flaring distally. Oral disc about 18 cm across, densely set with numerous radial rows of short digitiform tentacles up to ca. 5 mm long, and thrown into some 15 deep marginal folds; stomodaeum protruding through mouth; internal organs are to a high extend macerated.

Colour.— No data on the live specimen; preserved specimen pale greenish grey.

Anatomy.— Not studied due to the condition of the specimen. The macerated tissues contain numerous nematocysts. Zooxanthellae are abundantly present in the endoderm of tentacles, oral disc and mesenterial filaments in the distal part of the body.

Cnidom.— For a survey of the cnidom of the species see table 6 and fig. 46. Due to the macerated condition of the specimen it proved very difficult to obtain uncon-




Figs. 42-45. *Stichodactyla haddoni* (Saville-Kent, 1893). Variation of pinnate-circumscript endodermal sphincter. Fig. 42, from rather large specimen from Okha, India (RMNH Coel. 18431); fig. 43, from rather small specimen from Ambon, Moluccas, Indonesia (RMNH Coel. 18441); figs. 44-45, from a medium-sized and a small specimen from Inhaca Island, Moçambique (both RMNH Coel. 18443). Scale bars 0.25 mm; scale bar of fig. 42 also applies to figs. 43 and 44.

taminated tissue samples for a study of the nematocysts. Therefore, to avoid mistakes, the results were compared with the cnidom of better preserved specimens of the same species from Ambon, Indonesia (RMNH Coel. 18441) and Moçambique (RMNH Coel. 18443). The only previous survey of the cnidom of this species was presented by Dunn (1981: 85-87).

In the filaments penicilli A predominate, but spirulae, in two size-classes, probably are also common but less conspicuous in squash preparations because they have lost the usual refractile character typical of well preserved material. In the stomodaeum large spirulae predominate, but penicilli A are not rare. The tentacle tips are characterized by an abundance of spirocysts and spirulae, both types occurring in two more or less distinct size classes; a few spirulae of intermediate size (not listed in the table and not figured) were also found. The presence of two forms of spirocyst, a short and broad form (2a) and a long narrow form (2b), is note-worthy (the short and relatively broad size-class predominates in the tentacle stalks). In addition are present penicilly A (2e). In view of the possibility of contamination, the presence of

Table 6 (cf. fig. 46). *Stichodactyla haddoni* (Saville-Kent, 1893), survey of the cnidom of a specimen from Guajarat, India (A = RMNH Coel. 18431) and Ambon, Indonesia (B = RMNH Coel. 18441; specimen with extruded stomodaeum). For the codes on frequency see "Remark" on p. 602.

| Organ | Nematocyst type | Specimen | Mean and range (in parentheses) of length and width of nematocyst capsules in µm | N | Frequency |
|---|---|---|---|---|---|
| 1. Column | a. Spirulae | A | 9.3(8.0 - 11.1) × 1.8(1.8 - 2.0) | 20 | - |
| | | B | 8.0(7.1 - 8.9) × 1.7(1.6 - 1.8) | 10 | --- |
| | b. Spirulae | A | 15.4(13.4 - 17.4) × 2.2(2.0 - 2.2) | 30 | -/+ |
| | | B | 13.0(11.6 - 15.1) × 2.2(2.0 - 2.2) | 30 | -/+ |
| | c. Spirulae | A | 20.0(17.4 - 21.4) × 1.5(1.3 - 1.6) | 30 | + |
| | | B | 14.7(14.2 - 15.1) × 1.3(1.3 - 1.6) | 20 | + |
| | d. Penicilli A | A | 25 - 26 × 5.3 - 6.2 | 2 | --- |
| | | B | 24.0(21.4 - 25.8) × 5.9(5.3 - 6.2) | 20 | --- |
| 2.Tentacle tips | a. Spirocysts | A | 19.6 - 28.5 × 3.3 - 4.9 | — | ++/+++ |
| | | B | 17.8 - 23.1 × 3.6 - 4.0 | — | +++ |
| | b. Spirocysts | A | 22.3 - 48.1 × 2.0 - 3.1 | — | ++/+++ |
| | | B | 17.8 - 40.1 × 2.0 - 2.9 | — | +++ |
| | c. Spirulae | A | 9.1(8.0 - 10.2) × 1.8(1.6 - 2.0) | 25 | ++ |
| | | B | 8.1(7.1 - 10.7) × 1.7(1.6 - 2.0) | 20 | ++ |
| | d. Spirulae | A | 34.0(28.5 - 38.3) × 2.7(2.7 - 2.9) | 25 | +++ |
| | | B | 31.5(28.5 - 33.8) × 2.5(2.2 - 2.7) | 20 | ++ |
| | e. Penicilli A | A | 25.2(21.4 - 29.4) × 6.2(5.1 - 6.9) | 20 | -- |
| | | B | 24.1(22.3 - 25.8) × 6.2(5.8 - 6.7) | 20 | -/+ |
| 3. Stomodaeum | a. Spirulae | A | 27.5(24.0 - 30.3) × 3.7(3.3 - 3.8) | 30 | ++ |
| | | B | 25.4(21.4 - 27.6) × 3.6(3.6 - 4.0) | 25 | ++/+++ |
| | b. Penicilli A | A | 34.0(31.2 - 38.3) × 7.6(6.7 - 8.9) | 30 | -/+ |
| | | B | 31.4(29.4 - 35.6) × 6.6(6.2 - 7.1) | 7 | --- |
| 4. Filaments | a. Spirulae | A | 13.5(12.5 - 14.2) × 2.1(2.0 - 2.2) | 10 | +?[inc.] |
| | | B | 13.1(11.6 - 14.2) × 2.0(1.8 - 2.2) | 20 | -/+ |
| | b. Spirulae | A | 29.5(24.0 - 32.0) × 3.1(2.9 - 3.6) | 25 | -/+ |
| | | B | 29.9(27.6 - 32.9) × 3.7(3.3 - 4.0) | 20 | ++ |
| | c. Penicilli A | A | 29.6(26.7 - 33.8) × 6.2(5.3 - 7.6) | 25 | + |
| | | B | 31.0(27.6 - 32.9) × 6.1(5.8 - 6.2) | 20 | +/++ |

these penicilli was carefully checked and confirmed in additional specimens from Ambon (RMNH Coel. 18441; specimen 2) and Moçambique (RMNH Coel. 18443); they are present in both ectoderm and endoderm (among concentrations of zooxanthellae) of tentacle tips and stalks. In the column three size-classes of spirulae are present, one of which, a rather thin, irregularly curved category (1c), is characteristic of the species. However, the difference in size of these spirulae in the two specimens is rather striking. Therefore, additional measurements were taken from the above-mentioned specimens from Ambon [18.3(16.0-19.6) × 1.4(1.3-1.6) µm; N = 15] and Moçambique [24.3(21.4-28.5) × 1.4(1.3-1.6) µm; N = 20 and from a third, very small specimen from Thailand (RMNH Coel. 18444) [18.3(16.0-20.5) × 1.3 µm; N = 10]. It appears that the measurements taken from the two about equally large specimens from the same locality in Ambon differ considerably among themselves, thus indicating individual rather than geographical variation. Table 6 further shows that a few stray penicilli A were found also in the column of both specimens. This occurrence,

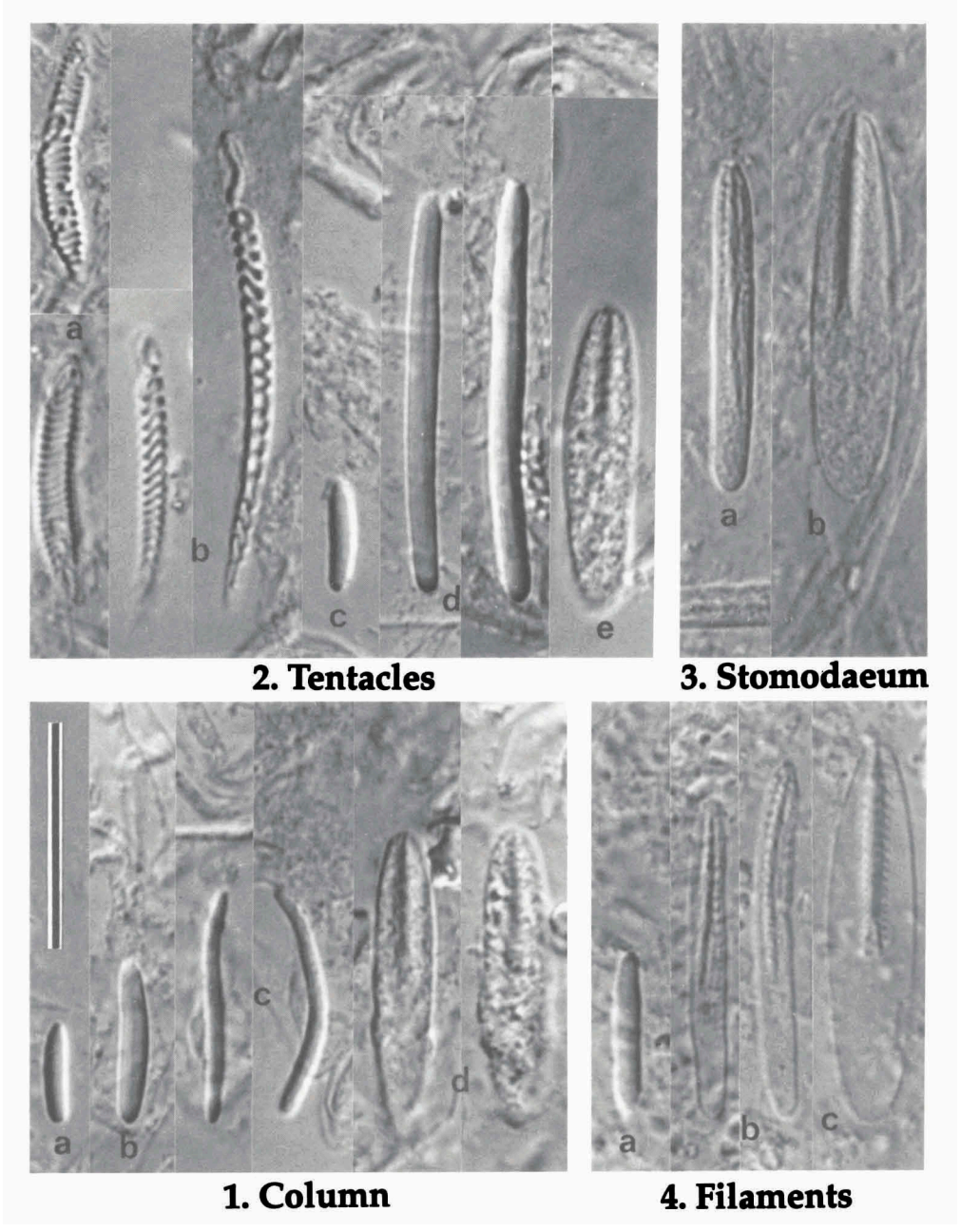



**Fig. 46.** *Stichodactyla haddoni* Saville-Kent, 1893. Pictorial survey of the cnidom of specimen from Okha, India (RMNH Coel. 18431). Figures and characters correspond to those in table 6. Scale bar = 20 μm. **1. Column**: a. Spirula; b. Spirula; c. Spirulae; d. Penicilli A. **2. Tentacle tips**: a. Spirocysts; b. Spirocysts; c. Spirula; d. Spirulae; e. Penicillus A. **3. Stomodaeum**: a. Spirula; b. Penicilli A. **4. Filaments**: a. Spirula; b. Spirulae; c. Penicilli A.

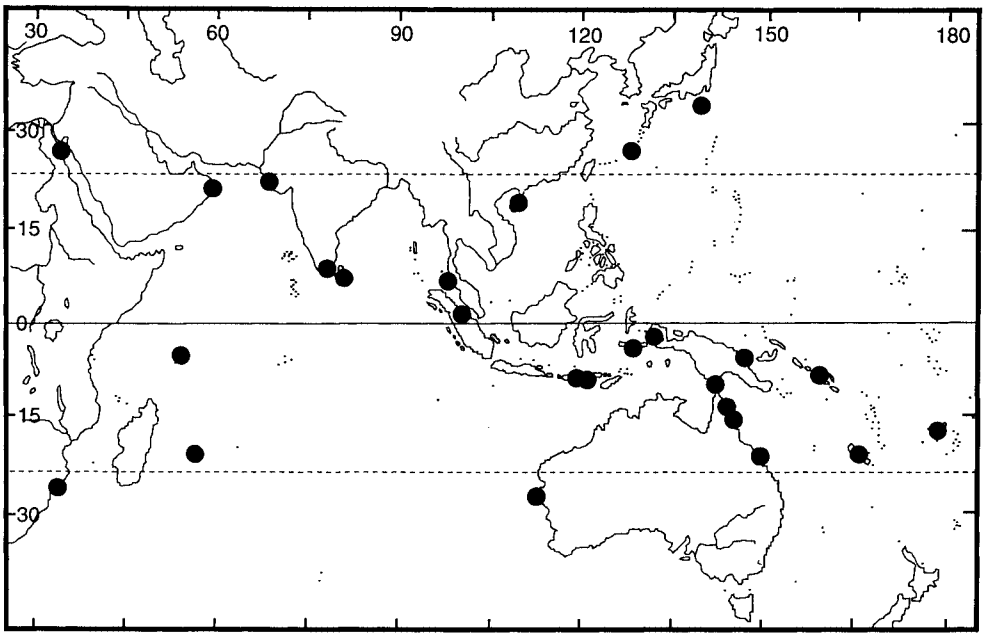



Fig. 47. Known distribution of *Stichodactyla haddoni* (Saville-Kent, 1893).
Sources: Dunn (1981) and the references cited by her; Fautin & Allen, 1992; unpublished data from RMNH collection, Leiden [Indonesia, Moçambique, Thailand]; collection Dr. Z. Tang, Qingdao, P.R. of China [Hainan]; photographic records by W. Kolvoort, Hattum, The Netherlands [Seychelles], and H. Debelius, Frankfurt, Germany [Oman].

too, was confirmed in the same additional specimens from Ambon, Moçambique and Thailand.

Distribution (fig. 47).— *Stichodactyla haddoni* occurs throughout the Indian Ocean and the central Indo-West Pacific, ranging to the west from the Red Sea and the Gulf of Oman southward along the East African coast to southern Moçambique (Inhaca Island, ca. 26°S), and to the east from the Izu and Ryukyu Islands (Japan) southward to the Solomons Islands, the Great Barrier Reef, New Caledonia and the Fiji islands.

Remark.— In the Indian literature on sea anemones this species has consistently been referred to as *Stoichactis* (= *Stichodactyla* ) *gigantea* (Forskål, 1775) (Menon, 1927: 38; Nayar & Mahadevan, 1967: 458; Trivedi, 1974: 387; 1977; Parulekar, 1990: 227), a species which so far has not been reliably recorded from the continental coast of India.

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Figures of the external morphology are from photographs by Ms. Ingrid Henneke (NNM). Histological sections were prepared by Mr. T.J.G.M. van Oyen and Mr. M.A. Slierings (NNM).

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